

***Sustainable ICS
Dissemination and Biomass
Supply in Rural Rwanda***

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Abstract

This research was conducted in a hosting organization, SNV Rwanda , which plans to intervene in the energy and forest sectors of Rwanda. The scope of the current study is threefold. Each interest is described from the point of planned intervention on behalf of SNV Rwanda. In the short run the production, dissemination and adoption of Canarumwe and Tekavuba firewood ICS in rural Rwanda is investigated. The aim is to find out how the products are made, who are the main actors involved, e.g. retailers, wholesalers, government, NGOs. At the same time consumers awareness and preferences are studied to draw some conclusions about the demand of firewood ICS in rural Rwanda. In the medium run, the supply of biomass (fire wood and charcoal) at markets, is scrutinized. Its costs, quantities and origin are taken into account. In the long run, strategic management plans for forest conservation and increase in tree cover are looked into.

Methodology: Structured questionnaires with open ended questions were utilized as a main methodology tool. The questionnaires include : Biomass market questionnaire, ICS market questionnaire, Production unit questionnaire and household questionnaire. The enquiry of the forest section of the study was done with the help of interviews.

Findings: Production of Tekavuba and Canarumwe is heavily dependent on donor programs for finance and skillful personnel with business and entrepreneurial knowledge. No formal market for firewood ICS exists in Rwanda, shown by both the market observations and the lack of contact with retailers and wholesalers. Households have low product awareness. The firewood bundles sold at markets come from public and government forests predominantly. Charcoal sellers have no formal contact with producers and trade with it sporadically due to uncertainty of supplies. Forest cover is being increased by seedlings planting. New personnel are hired at the corresponding agencies to ensure success in national targets.

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List of Abbreviations

ICS	Improved cook stove
PU	Production Unit
EWSA	Energy Water and Sanitation Authority
HH	Household
NAFA	Rwanda National Forestry Authority
DFNC	Department of Forestry and Nature Conservation
IAP	Indoor Air Pollution

Chapter 1

1.1 Introduction and problem definition

Developing countries have been experiencing severe shortages of technical innovations where energy efficiency is concerned. For the most part, the main fuels for the populations of such countries are wood, charcoal and crop wastes. This trend has several negative implications. On one hand, the environment is degraded in terms of both depletion of natural forests and atmospheric pollution by smoke (Makonese, 2006), while on the other hand, families spend long hours collecting wood and agricultural fuels and suffer from indoor pollution which has adverse health effects such as sight and respiratory problems. Adoption of modern energy sources such as petroleum products, electricity and alternative fuels has been initiated in a number of countries but the large scale of the problem combined with the resource and investment limitations has proved to slow down the process substantially. As an alternative, new fire wood and charcoal stoves with increased efficiency have been invented and disseminated in developing countries in order to reduce biomass consumption. (Barnes, 1994)

Nevertheless, this has turned out to be a painstaking work, too. Even after the efforts of both governments and non-profit organizations, many African countries still have low levels of improved cook stoves (ICS) utilization. There are different reasons for the failure of many programs aiming at ICS introduction among rural communities spanning from relatively high prices of ICS to insufficient information on where ICS can be found (Wanjohi, 2006). On other occasions, users claim the food tastes different or that the stoves are not comfortable to use (Sarkar, 2006). In addition, recent studies indicate many people purchase ICS to comply with government recommendations without using them afterwards (EUEI, 2009).

Rwanda appears to be an exception among its counterparts in terms of ICS adoption rates. According to Nungo (2012), 54% of the population use some type of firewood ICS (Rocket Copama, Rocket Gisafuria, mud stone wall and the most common one – Darfur, 42%) while 7% use charcoal stoves. Recently, the Energy Water and Sanitation Authority (EWSA) has initiated another program of ICS production and dissemination throughout rural Rwanda. Different models of stoves had been tested and two models had been selected as the most appropriate – Tekavuba (“cook fast”) and Canarumwe (“use one stick”). Both of them have considerably higher efficiency gains at 40% and 49% less fire wood consumption compared to traditional fire for Tekavuba and Canarumwe, respectively. Production units were set up and potters were trained into moulding the new stoves, volunteers were trained and different information channels (radio, umuganda-collective activity, door-to door education) were used for promotion purposes and awareness creation. As a result 24 783 stoves were produced. However, only 12 174 stoves are in use even though the stoves were given away for free to households by different organizations such as Practical Action and Millennium Villages.

The purpose of the current study is to closely examine the production organization of the two models – Tekavuba and Canarumwe, the adoption levels of ICS in general among families and the contribution of ICS to the alleviation of the biomass availability problem in rural areas.

SNV World is non-for-profit organization that operates in 36 developing countries aiming at helping communities pursuing “their own sustainable development”. Its main focus areas are agriculture, water, sanitation and hygiene and renewable energy provision.

Unlike other development organizations SNV does not provide funds but tries to facilitate the diffusion of sustainable practices (snvworld.org). The aim of SNV Rwanda is to investigate, evaluate and propose a solution for transforming the ICS sector into fully independent and successfully running enterprises which do not need government subsidies. In order to do this the research will focus on both the supply and demand side of the ICS industry, and especially the new Canarumwe and Tekavuba stoves. On the supply side, production modes, retailing and promotion will be taken into consideration. This includes the type of enterprises that currently exist and their organization (e.g. family business, companies, cooperatives), sources of raw materials and their accessibility, production standards to name the most important aspects. Then, the study will focus on the wholesalers and retailers and the ways in which ICS reach final users. Finally the actors who take the lead to introduce new products within the rural population will be identified. The study will be conducted by interviews with local producers, salespeople at markets and households.

The second objective of the research is to shed light on the firewood and charcoal consumption by families and their availability and prices at markets. In addition, information on where wood fuels come from will be provided.

In the long run, the interest falls in the forest management domain and the practices which are to be adopted to ensure forest conservation in Rwanda. The target of Vision2020 (a document describing Rwanda's goals) is 30% forest cover, therefore meetings and discussions with forest officials took place to clarify their position on this matter. Main research interests are data availability, contribution of public discussion to reforestation, possible formation of community cooperatives and strategic management plan for reforestation. This section of the overall study is mainly focused on the institutional level and the measures local authorities and the government plan to implement.

1.2 Background

The research focus is on areas where the wood fuels shortage is pronounced the most. Rwanda has five provinces and the Eastern one has the highest rural population of all - 96.4%, and also it experiences severe shortages of fire wood. For these reasons, the research takes place in two of the Eastern districts – Bugesera and Kirehe. The other two districts which are part of the study are Kamonyi in the Southern province and Rulindo in the Northern province. Both of them are quite similar to the eastern districts in the sense that wood fuels are increasingly becoming an issue for the local people. In Kamonyi 77.7% of the population relies on fire wood while Rulindo has the highest fuel wood consumption (90.6%) in the whole Northern province complemented by the lowest utilization rate of other sources (1.6%). (AESG, 2012) There are Tekavuba and Canarumwe production units in all four districts which eases the evaluation of ICS dissemination in the countryside at locations that are relatively close to the production units. Figure 1 serves to illustrate the districts where the survey took place.

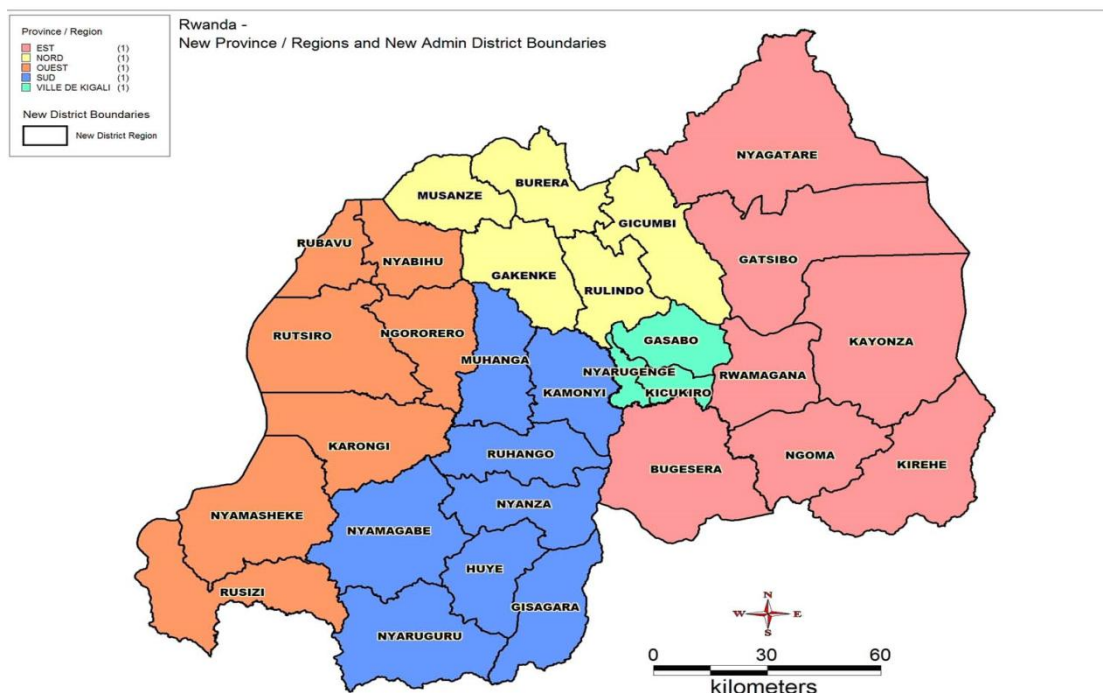


Figure 1: Map of Rwanda

1.3 ICS Definition

Due to the fact this study is mainly focused on ICS, it is important to point out what is regarded as an improved stove. An Improved cook stove is an umbrella term that encompasses many different models of stoves. There is not a unified definition of ICS. However, there is some agreement among scholars and scientists that an improved cook stove is superior to a traditional fire in terms of fuel efficiency and smoke reduction due to better combustion and possibly facilitating cooking itself. Since the traditional fire is used as a reference base it is important to note what is considered as such. For the purpose of this paper a 3 stone fire is designated to be a traditional fire.

Different authors give different fuel efficiencies as an indication that a stove is improved. According to Owsinianowski, a 50 % reduction in fuel consumption can be treated as an improvement.

The stoves of main interest in this study are Canarumwe and Tekavuba with 49% and 40% fuel use reduction respectively. Nevertheless, a self constructed mud stove known as rondreza which is very popular in rural Rwanda will be also treated as an improved cook stove due to the fact users claim it does have an efficiency advantage over a 3 stone fire. In addition, the construction of these stoves has been initiated by different programs which had developed the technique or borrowed it from elsewhere. What is more, EWSA have initiated a program disseminating a mud stove but was rejected due to quality standards issues (personal communications, former collaborator of EWSA). A study from North Kordofan-Sudan demonstrates that an improved mud stove has 26% and 36.5% higher efficiency in terms of high power and low power constant boiling water tests. (Elhadi, 2009)

The price for both Tekavuba and Canarumwe is 3000 Rwf.

All costs in this study are presented in Rwf. To give an idea of the reader, 600 Rwf equal US \$1 approximately as of the period March-April 2012.

1.4 Research question(s)

Having in mind the above mentioned problems - ICS sustainable dissemination, decreasing fuel availability and forest management, the following question will be investigated:

What possible measures can be adopted in order to ensure sustainable ICS dissemination and biomass supply in rural Rwanda?

This question encompasses several problems at the same time. The low availability of firewood which is the dominant fuel of rural parts of the country is closely linked with the adoption of ICS. The purchase of ICS is motivated by the long hours spent gathering firewood and sometimes without success. At the same time biomass collection leads to further exploitation of forest resources. The creation and enhancement of a market oriented approach towards ICS is crucial in order to ensure continuity of adoption and use. Therefore, the current situation needs to be studied and based on its evaluation, measures can be proposed to lay the foundations of enterprises which produce and distribute firewood stoves. Answering the main research question will be facilitated by first exploring five sub questions which address all the components of the main one.

1/ What production, diffusion and promotion practices currently exist and how these can be improved?

The purpose of this question is to find out what has been the outcome of the latest ICS donor program that took place in Rwanda. The ability of production units to continue work on their own constitutes a special interest, what labor organization and division is present and how efficient it is. Next point of research is the supply chain by which a stove reaches end users. What retailing and wholesaling system is established. Last, the promotion campaigns and methods utilized to increase awareness among communities of the existence and benefits of Tekavuba and Canarumwe stoves.

2/What is the cooking environment and households' attitudes towards ICS?

This question has the purpose of understanding households' preferences when it comes to preparing food. What also constitutes an interest is the level of awareness of households of efficient stoves and their willingness to adopt them.

3/ What are the main types and sources of fuel in rural areas?

This sub questions aims to reveal not only what the dominant fuel in rural areas is but also what other fuels are used and complement the energy mix of rural households. This is essential to know because it might be the case these fuels are not appropriate for use with the stoves in question which can result in a major bottleneck for adoption. At the same time, where these fuels come from is related to the deforestation issues of the country.

4/What production and supply practices currently exist at the biomass (fire wood and charcoal) market?

The production of charcoal is important in relation both to forests and households' utilization. What techniques are employed and how it is afterwards distributed and which are the main markets for it. Firewood also has its market share even though the percentage of people buying firewood is substantially less than those who gather themselves. Where the firewood bundles are collected, who engages in fire wood sales and what is the market organization is addressed in this sub question.

5/What measures the government of Rwanda plans to implement to save and increase its forest cover?

The last subsection deals with the motivation at institutional level to tackle the problems of reduced forest cover in the country and to reduce biomass reliance in general.

The first and second sub-questions relate to the first objective of the study, namely transforming the production and diffusions of stoves into sustainable business venture.

The third and fourth sub-questions refer to medium term interest, which is the organization of the wood fuels market in rural areas.

The last sub-question deals with the third objective, forest issues and management.

This dissertation is organized as follows:

Section 2 is. a literature review looking into major bottlenecks of ICS dissemination in previous cases Chapter 3 gives an overview of the methodology applied in the study. Section 4 provides the results and discussion of the field research that took place .Last is the concluding chapter in Section 5.

Chapter 2: Literature Review

2.1. Forests

2.1.1. Importance of Forests and Impacts of Deforestation

Forests are important for numerous reasons spanning from regulating water and nutrients flows to creating habitat for half of the world's flora and fauna. Forests protect from fire spreads and reduce soil erosion, as well. With world's population constantly on the rise, more and more forests are cleared out and converted into pastures, living spaces or simply exploited by forest industry.

Alternating forest landscapes leads to changes in regional climate. Reduced rates of evaporation and consequently rain, may put primary forests in danger of fires. Amazonian basin clearly indicates a correlation between land use change and increased rate of fires (Aragao,2007).Rainfall can be substantially reduced as well due to the fact that some meteorological mechanisms are disturbed and therefore agriculture and ecosystems can suffer from the effects (Meher-Homji,1991).

What plays a significant role in landscape conversion is the type of newly introduced ecosystems and the size of their areas. Pastures, for example, have up to 40% less evaporation in comparison to native forests. In addition, remnants of forests create a natural barrier against the spread of fires. This is especially true in the case of rain forests whose canopy prevents the sun radiation from penetrating beyond the crown of the trees and therefore the leaves and twigs fallen on the ground remain humid and therefore less flammable. When new ecosystems are introduced the risk of fire is higher due to the fact their near the ground layer is larger in size or less moist in comparison to primary forests. (Schelas et al.,1996)

In addition, forests prevent or decrease run-offs. A study conducted by Farley et al. (2005) demonstrates that afforestation in area with run off of 10% of precipitation will be sufficient to entirely eliminate it, while in regions with 30% runoff it can cut it by half or more.

Reduced tree cover can also lead to soil erosion since there are no natural barriers to keep the soil from run-offs. It is often combined with clearing land for agricultural purposes which furthers soil degradation and sediment yield. (Lal,1996)Some research conducted in the Deforestation can be blamed for high GHG emissions, too. Some current projections are that 18% of GHG is attributable to cooking with biomass fuels when deforestation is taken into consideration.(AFREA,2011)

To sum up the consequences of all mentioned advantages of forests from a social point of view, destruction of forests limits the capability of countries to grow food, have adequate fresh water supplies, natural protection from fires and the access of local people to wood fuels. (Tole, E., 1998)

2.1.2. Main Drivers behind Deforestation

Deforestation is triggered by different processes. Some of them are country-specific; others apply to various geographic regions regardless of historical backgrounds.(Helmut,2002) In general, scarcity and development are the main causes of deforestation. Millions of people depend on forests for medication, fire wood, timber and other everyday life purposes. With increasing rates of population growth more land is cleared for living spaces and agriculture. At the same time, since wood fuels are the main energy source for developing countries, the pressure of firewood gathering and charcoal production also intensifies. The way out of forest exploitation caused by scarcity is economic development, which by itself is a main driver of deforestation. Therefore, alleviating the pressure put on forest resources seems to be a vicious circle. A glimpse of hope comes from the theory that after a certain threshold of income is achieved, development actually

starts to suppress resource depletion, known as Environmental Kuznets Curve (Yandle et. al., 2004). A correlation between economic development and less exploitation has been found for a number of different environmental problems. However, there is no connection between lower rates of deforestation and improved standards of living, or this threshold is in the distant future. A study covering 76 developing countries and a time frame of 31 years finds no indication for the presence of the Environmental Kuznets Curve (Koop et. al., 1999).

As already mentioned, the most frequently stated reasons for deforestation are agriculture, infrastructure development, fuel wood gathering and timber production. However, more and more researchers go beyond the land use practice that leads to deforestation and try to identify the socio-economic factors behind forests depletion. Growing population and low productivity of land drives people to migrate to new areas where ecosystems are fragile. No land ownership or inequality of land distribution also exacerbates deforestation by forcing people to marginal areas. What is more, steep regions, inappropriate for farming are being increasingly utilized. The crop growing practices applied are often unsuitable which leads to further environmental degradation. This often coincides with the fact poor countries sell their natural resources at a low profit, seeking to pay their foreign debts, for instance. Besides, developing countries are also more endowed with forests (56% of world forest cover, FRA 2000) and foreign companies tend to exploit these natural resources for commercial logging and large scale farming. Thus, further restricts the resource availability to local people and their ability to get out of poverty. In addition, traditions in community oriented governance of forest resources is vanishing in the face of increased centralized control. Government failures in terms of management are reflected in larger volumes of forest products exports as a response to price level increase at international level. At the same time, individual decisions play a vital role, as well, by responding to economic opportunities. (Helmut et al., 2002)

2.1.3. Main Stakeholders

Governments and intergovernmental bodies have put efforts in estimating rates of deforestation and finding ways to slow it down for decades. Nevertheless, there is still a long way to go in terms of standardizing practices and adopting measures to solve the problem. The quality of forest cover data provided from the majority of developing countries and some developed countries, as well, is poor which hinders the design and implementation of afforestation and reforestation programs (Matthews, 2001). The Food and Agriculture Organization (FAO) of the United Nations conducts research at worldwide level every 10 years to provide estimates of forest cover. In 1990 a baseline study took place based on which comparison of world forest cover is made. Some optimistic results have been presented in more recent evaluations of forest cover (Matthews, 2001). However, it seems they are the outcome of changed methodology of data collection and interpretation and not of improved state of forests. To give several examples of why such improvements may be illusive, different measurement techniques are applied, definitions vary from country to country, therefore making aggregating data and comparing with past periods challenging. (Matthews, 2001)

NGOs also play a crucial role in forest management and international policy concerning forest exploitation and forest products. Usually, NGOs deal with two sets of problems. The first, concerning the forest from ecological and conservational standpoint, while the second set of issues focuses on human rights and abilities of local communities to exploit their own immediate environment (Humphreys, 2008). Local communities are largely recognized for their contribution of knowledge and have to benefit as well if any of their know-how is used for commercial purposes. NGOs differ in the sense that some prefer a more outside tactics to reach institutions while others rely on insider approach for negotiations. Regardless of their approach to achieving the goals, NGOs are similar in their objectives which are restoring forests to as much of their original state as possible. They go even further in their efforts to ensure that reforestation is sustainable from both social and ecological point of view. What triggers the need for NGOs participation is the argument that forests are exploited largely due to economic interests. This

requires a shift of powers from the top (government) to the bottom (local communities), where NGOs play a role of mediator. In addition, NGOs participate in international forest negotiations such as United Nations Conference on Environment and Development (UNCED), United Nations Forum on Forests. Negotiations on forest products, for instance, International Tropical Timber Organization talks on international trade of tropical timber and the discussion organized by the World Trade Organization (WTO) in 1990s, are not neglected by NGOs, either. (Humphreys, 2008)

A study of the Canadian Forest product sector illustrates that different perceptions among managerial personnel on stake holders involvement brings different results. Stakeholders influence better practices in terms of pollution control, recirculation of materials, sustainable harvesting of timber and to some extent locating firms in areas where they can make use of one another's wastes. (Sharma et al., 2005)

Apparently, all stakeholders involved in the forest are important to the sustainable solution of the deforestation problems locally and globally.

2.1.4. Reforestation

In case of reforestation secondary, faster growing trees are introduced to a region with originally mature forest. These new trees, however, are more prone to forest fires and can further decrease the overall forest cover of a region (Naughten –Treves, 2007). The changes in flora as a consequence cause the change in fauna as well due to habitat loss. Forests are home to many unique species which are threatened by extinction due to destruction of their environment. For many developing countries deforestation can also be the cause for reduced financial income previously generated by tourism. This would be the result from decrease in services which national parks provide to visitors since plant and animal species have been drawn to extinction or are severely reduced in numbers due to diminishing forests. (Konnaird, 2003)

In addition, some studies indicate that planted forests have higher levels of stored carbon and acidification, water consumption along with the fact they create habitat for fewer species in comparison to natural ones. Meanwhile, others claim that Eucalyptus planted in dry tropic areas have no higher water consumption than unmanaged hardwoods. Even though, there are some forms of biodiversity that can be sustained only by old-growth forests, with appropriate techniques a planted forest can create habitats for various species. (Cannell, 1999)

2.2. Charcoal Production

Despite the above mentioned detrimental effects of forests exploitation, the wood fuels sector is important for most developing countries' economies. In Rwanda, for example, charcoal production has larger value than coffee exports which is one of the main export products of the country (US\$50 M compared to US\$38 M or 2% of GDP). Charcoal being mainly an urban or peri-urban fuel, has an essential role for restaurants and institutions such as schools, prisons and hospitals. The annual institutional charcoal consumption in Rwanda amounts to approximately 1, 7 M kg. (AESG, 2012)

This has important implication in the sense that many people depend on fire wood sales and charcoal production for a living. It is an important sector of the economy and employs large fractions of the population. In Malawi, for instance, it gives jobs to 92 800 people, engaged in different activities spanning from production and transport to trade. (Kambewa, 2007) In Africa in

general, the number of people employed in the charcoal sector is expected to be around 12M by 2030.(AFREA,2011)This only comes to show the significance of biomass use and production in developing countries and strengthens the opinion that a change to other means of energy will be slow, gradual and difficult. Meanwhile, improved efficiency in charcoal production, for instance, and better combustion for biomass fuels as a whole can be implemented to reduce the scale of damage.

A body of research indicates that soils where charcoal kilns are situated have higher levels of soil richness and water retention. (Oguntunde et al., 2008)This concept is gaining popularity and proposal that charcoal can be produced in national parks circulates around scientific community. Return to traditional production techniques, namely constructing kilns directly in forests, is cheaper, and workers do not need to migrate to find jobs. Meanwhile, others studies point out that charcoal production does have negative impacts on soil composition. (Fischer, 1998)

2.3. Cooking Practices and Improved Cook stoves

Poverty (or scarcity) deprives communities from climbing up the energy ladder, meaning switching from dirty fuels (wood fuel, dung and agricultural wastes) towards clean fuels (LPG, electricity)(Jack,2004).This means that the majority of the population relies on biomass for its energy needs which are primarily cooking and to some extent heating. In Sub Saharan Africa this trend is especially pronounced amounting to 81% of the population. Even though this characteristic is applicable to developing countries as a whole, most of them have either peaked in biomass use or are soon expected to reach its height and gradually start to decline. There is no indication that the trend will soon be reversed for the Sub Saharan African region. (AFREA, 2011)

2.3.1. Indoor Air Pollution

Cooking with wood fuels has a number of negative implications. An obvious bad effect is the health impacts produced by smoke emission. Among the most often stated illnesses are respiratory or eye diseases. Exposure to smoke increases the chances of blindness and especially partial blindness (Mishra, 1999).

The detrimental effects of IAP has actually earned it the fame of “silent killer”(Edelstein,2008).The particulates emitted while cooking can also lead to the development of chronic obstructive pulmonary diseases, lung cancer and acute respiratory infections to name just a few, especially among young children (Edelstein,2008). Since cooking is women’s domain, it is them and children helping with the house chores, who bear the negative effects the most. The effects of dirty fuels can even become apparent in the underweight of babies born to mothers using dung, fire wood or charcoal. (Mishra,2004) .A small body of research indicates that IAP can increase the risk of other illnesses such as middle ear infection, cataract, nasopharyngeal and laryngeal cancer(von Schirnding,2002).In short, IAP alone can be the cause for 2 million deaths in developing countries.(Bruce,2000)

To further exacerbate the situation cooking indoors and bad or no ventilation further contribute to the magnitude of IAR (Bruce,2000).This can be partially alleviated in tropical and sub-tropical areas which are reported to have higher levels of ventilations since cooking spaces are open to the outdoors(Smith,2000).

Drawing on the above mentioned factors it appears that air pollution is not an urban phenomenon as many people would expect. On the contrary, rural households in developing countries suffer the effects of indoor air pollution on an everyday basis (Smith, 1993).

2.3.2. Deforestation

The second threatening aspect of biomass used for cooking is deforestation. Both households and institutions rely on wood fuels for meeting their energy needs. With rising levels of population the demand for wood fuels is on the increase. Forest cover decreases with high rates due to over exploitation for fire wood or charcoal production. The manifold negative impacts are described in the previous section in more detail..

In order to slow down the rates of environmental exploitation, namely deforestation and to improve cooking conditions with relation to hygiene, comfort and health, improved cooking devices were introduced in a number of developing countries. ICS dissemination programs have been conducted with varied success in many developing countries since the 1980s'. The literature accounts for a number of most commonly encountered drawbacks when it comes to actual adoption among communities.

2.3.3. Traditions and Preferences

To begin with, for a lot of people cooking in traditional fireplace is a matter of habit, tradition and customs. A common belief is that if the ancestors did it the same way for generations then it cannot be harmful even when efforts are made to explain the benefits of ICS. Therefore, it is often the case that families are reluctant to use ICS. This is usually combined with other factors that campaigns seem to ignore. One such factor is cultural context. For some societies certain rules apply and if those are overlooked the donor program is doomed to failure. A well known example is the attempt to popularize solar cookers (Clancy, 2002) In some societies these stoves are simply not applicable due to the fact it is established that cooking takes place indoors. The fire place is where the whole family gathers and women attend to their children while taking care of their daily activities. Taking the woman out of the kitchen reduces her participation in the family's interaction. (Wilson and Green, 2000)

Such occurrences are often exacerbated by the fact taste of food is significantly different from the one prepared on a three stone fire. This can be confirmed for many different models of ICS. (Karekezi, 2002)

2.3.4. Attitudes to Health Problems and Designs

What is more, advocates of ICS stress the high reduction in smoke emissions in comparison to traditional modes of cooking. Even though, more and more scientific evidence comes to show the detrimental health effects of IAR, a small fraction of users seem to be troubled by the smoke. Therefore, one of the main advantages of ICS is not equally crucial as it is to the ICS promoters. (Mobarak, 2012)

Comfort of use is an issue quite often overlooked as well. ICS designs do not take into account the size and shape of pots that targeted consumers use. If a pot is too large for a given stove then it is not well fixed on it and it is more inconvenient for women to stir, for example, and often leads to breakage of the stove. Once broken a stove is usually difficult to repair or to be replaced because most of ICS are provided by donor programs and once the program is over no continuation of supply is established. This means that ICS cannot be found before another program commences unless there is a market for ICS which is possible in the case of charcoal stoves used in cities and towns but very rare for firewood stoves used in the countryside. (Barnes, 1994)

2.3.5. Attitudes to Time and Budget Savings

In terms of biomass use reduction, the main argument is that households save on their budget and can therefore use it for other goods. This can be a powerful adoption incentive but at the same time it is worth noting that for the most part families gather their fire wood and only a small

percentage actually purchase it (except for charcoal, of course). Therefore, the savings appear to be time-wise. This implies that women and children will spend less time collecting firewood. Nevertheless, for some users it is an advantage while for others is not. Some women prefer to stick to the traditional fireplace because they fear the extra time they gain at their disposal should be used for some other heavy house tasks (Clancy,2002;Jackson,1998). In addition, surveys indicate men are also reluctant to adopt new time-saving technologies due to worries about the activities their wives are going to engage in.(Clancy,2002;Wilson and Green,2000)

2.3.6. Effects of Government and NGOs Intervention

Nevertheless, a lot of families have an improved stove. It is worth noting that this can be simply the results of government recommendations. Governments often unite with NGOs in ICS dissemination to alleviate deforestation and also to promote women empowerment.

In addition to the above mention bottlenecks, the abundance of donor programs has negative impacts on household members' mindsets. On many occasions, efforts to develop a market for ICS meet difficulties for people are discouraged to invest in the purchase of ICS. Having various projects disseminating ICS complimentary, families have low motivation to pay for goods they would otherwise obtain for free. What is more, sometimes the local artisans who produce the stoves (if the model is made of clay, for instance) have low social status and the price of the stoves seems too high for the local communities. (Nungo,2012)

2.4. Country specifics

Each country has its own characteristics and they need to be carefully evaluated if a market approach is to be implemented as a tool for ICS dissemination. Therefore, studies have been carried out to point out the strengths, weakness and opportunities for an ICS market development in target countries. The ICS sector in Rwanda appears to be a good environment for enterprise development due to several factors. In general, the government of the country is deemed as progressive and reliable (Accenture, 2012).The administrative divisions are clear and policies are distributed and implemented successfully and rapidly to the grass root level. Every village has a representative, who is responsible for dealing with fellow villagers problems. Several villages are united into a cell. The next administrative level is sector which is the followed by a district. The last building block of the administration is province.

In addition, the current government has the reputation for zero corruption and is noted for its gender equality contributions. With respect to the ICS industry, it has initiated some ICS programs itself already with the help of its implementing body (EWSA).Another favorable factor is that Rwandan population is characterized by high primary school attendance(Accenture,2012). Access to education can positively affect consumer choices in the sense that people are more aware of the advantages of ICS. Combined with better understanding of the ICS qualities and low availability of firewood can be a significant incentive for households to invest in ICS in order to save money and time. However, a number of drawbacks are also present. The main bottle neck appears to be the high level of poverty and little available income(Accenture,2012). It is often the case other goods are priority for households. This is supplemented by weak ICS industry in terms of production scale and quality guarantee combined with no access to ports and rail ways and therefore possibilities for import are also limited. Distribution in Rwanda itself is also difficult and availability of stoves in rural areas is low. However, government and NGOs are currently becoming more and more involved in the sector which can increase the industry presence and improve distribution channels. The low production can be increased by training of local artisans which is already taking place. (Accenture,2012)

Chapter 3: Methodology

The interest of this study is threefold:

- To get an insight into the supply and demand of improved cook stoves
- To understand better the supply and demand for wood and charcoal in rural areas
- To find out the approaches taken by local authorities in order to fight deforestation

First, previous success and failure stories in the ICS sector have been examined. This is supplemented by an overview of the business potential of Rwanda itself.

Second, a literature review on deforestation and effects of charcoal production has been conducted.

Lastly, primary data will be gathered with the help of questionnaires applied to the different parts of the study.

In order to reach the first objective, namely to understand the current ICS situation in Rwanda, three different questionnaires are applied (See Figure 2). This is necessary to cover both the supply and demand sides of the market for ICS. The Production Unit questionnaire deals with raw materials procurement, equipment types and availability; potters organization and revenues (See Annex B). Six out of six-teen PUs were visited and questioned.

This questionnaire also gives some information about the connection with retailers and wholesalers of ICS. This information needs to be enhanced by the next tool of the research which is the Market of Improved Cook Stoves questionnaire. It has the purpose of identifying availability of ICS products at markets, their quantities and prices, retailers and wholesalers and also consumer preferences (See Annex B). Only two ICS sellers were found and interviewed.

The demand side is investigated with the help of household questionnaires. It has a double scope aiming at revealing the cooking conditions and preferences but also the energy consumption of households (See Annex B). The questionnaire was applied to 51 HH. Both users and non-users of ICS are included in the study. Non-users are respondents who have never used ICS, while users can be HH which currently do not have the device but have had one in the past and are therefore knowledgeable of its properties.

Since one of the main objectives of this study is to evaluate the possibilities for a market oriented approach of ICS distribution in rural areas, the willingness to pay of consumers is an important element. Willingness to pay is defined as the maximum amount of money respondents state they are willing to give up in order to obtain an ICS, where by ICS a Tekavuba or Canarumwe stoves are meant. Therefore, the qualities of the two stoves are explained to respondents with emphasis on their fire wood consumption reduction. Since it is obtained by questionnaires it is a direct WTP (O'Brien, 1994).

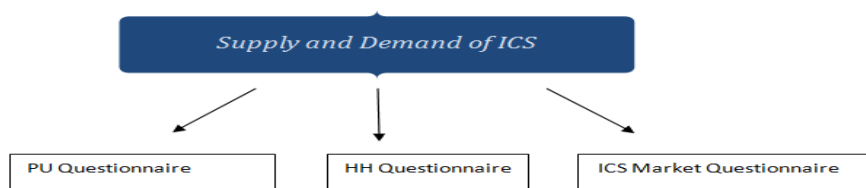


Figure 2: Supply and Demand of ICS

The second part of the study relies on the Market for Firewood questionnaire that deals with problems of wood supply and demand at markets, quantities and prices of wood and charcoal (See Annex B). 12 sellers were interviewed in the four districts in total. It is further complemented by the second part of the HH questionnaire which sheds some light on the biomass consumption of families. Figure 3 below illustrates the questionnaires used.

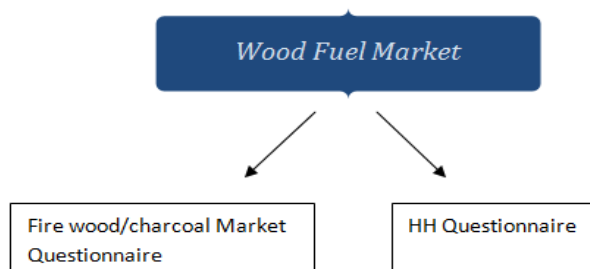


Figure 3: Wood Fuel Market

For the long term objective, to examine the forest management plan, interviews with forest authorities are utilized to increase our understanding with regards to the strategic plan of local authorities in terms of forest cover and preservation (See Annex B). One interview with the Director General of Forestry Field Program is conducted and it differs from the questionnaires utilized when meeting with local officials due to the different tasks they have (See Annex B). The methods applied are demonstrated in Figure 4 below.

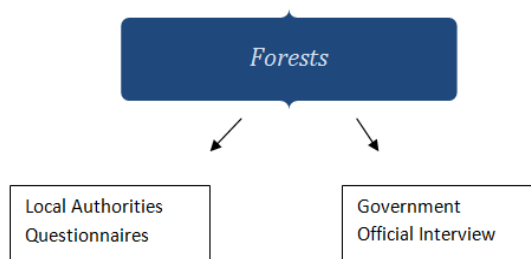


Figure 4: Forests

Chapter 4: Results and Analysis

4.2. Production Units Overview



Figure 5: A Poster in Nasho PU

Driven by the urgent need to improve the efficiency of biomass utilization in Rwanda, the Ministry of infrastructure, in collaboration with Energy Water and Sanitation Authority (EWSA) and the non – governmental organization Practical Action, has endeavored to introduce new improved cook stoves in rural Rwanda. The campaign aimed at distributing 22 500 ICS in rural areas. To achieve this goal, the production of the new models- Canarumwe and Tekavuba had been organized by training potters in the intervention areas to mould the new stoves. According to the efficiency tests that have been conducted in order to choose the most appropriate models to fit the specifics of rural Rwanda, the efficiency gains for Canarumwe is 49% reduction in biomass consumption, and 40% for Tekavuba. Local production units were established and equipment has been provided by the campaign. Potters at these production units received errands from the locally operating projects (Millennium Villages in Bugesera and Practical Action in all other areas covered by this study). These errands were afterwards distributed among local population. Basically, the main demand for stoves came from these projects. Occasionally, stoves were sold to households, mainly neighbors of the artisans producing them.

The marketing strategy for these newly created enterprises included logo development to facilitate the recognition of the products, equipment and promotion materials procurement.

There are production units (PU) in 15 districts on the territory of Rwanda. The current overview is written based on interviews conducted in 6 PU in 5 different districts (Bugesera (2 PU), Kirehe, Kamonyi, Rulindo and Muhanga). Muhanga district is not represented in other parts of the research but was visited just to shed additional light into the production of improved cook stoves.

The workers in all production units are originally potters. They were additionally trained to mould improved cook stoves of Canarumwe and Tekavuba models. The table below presents the number of workers and their average productivity for all PUs.

Daily Capacity

PU	Stoves per day	Nº of potters	Productivity per worker per day
Bugesera,Kanazi	49	7	7
Bugesera,Mayange	78	13	6
Kirehe,Nasho	60	19	3
Kamonyi,Runda	155	31	5
Rulindo,Base	*	23	
Nyamabuye,Gitarama	20	18	1
Min	20	7	1
Max	155	31	7
Average	72,4	18,50	4.6

Table 1: PU daily capacity

*Work is organized in a different manner. Potters take turn to come to PU on different days and do different tasks.(See Appendix 3)

4.2.1. Raw Materials

The raw materials used by all PUs are clay and potter sand. There is not a specific type of clay used. On one occasion (Kamonyi) two types of clay from different locations are mixed in order to ensure good quality. The raw materials do not cost anything, since the district authority provides the potters with permit to exploit some land where potter sand and clay are found. The transportation of these to the production site however can be quite costly or difficult if carried out by the workers themselves. Due to this reason raw material collection is generally considered a difficult task. Some PUs consider water as a raw material as well. However, the majority state it only when asked for additional costs.



Figure 6: Clay preparation at Kirehe PU 25.04.2012

4.2.2. Direct Costs

Having in mind raw materials are provided to PUs for free by the government, the production costs that artisans have are for water (on only one occasion), transportation of the clay from the site it is collected to the PU, firewood needed for firing the kiln and in the case of other costs like daily allowance for potters taking stoves to the market. The table below illustrates the minimum, maximum and average costs for all these per PU and as a whole. The numbers reflect both Canarumwe and Tekavuba costs.

Costs per Stove (Rwf)

PU	Water	Firewood	Transport	Other costs	Total Cost per PU
Bugesera,Kanazi		83,30	600,00		683,30
Kamonyi,Kigina		157,90	1000,00		1157,90
Rulindo		416,70	42,86	1100,00	1559,56
Kirehe,Nasho		238,80	0,00		238,80
Bugesera,Mayange	1	229,00	333,30		562,30
Kamonyi,Gitarama		154,00	0,00		154,00
Average		213,28	329,36		725,98
Min		83,30	0,00		154,00
Max		416,70	1000,00		1559,50

Table 2: Costs per Stove for each PU and in Total

The cost of water is known only for one PU, namely the one in Bugesera, Mayange and it is only 1 Rwf per liter of water which is enough for mixing the clay needed for one stove. The other PUs either have not mentioned water as a material or obtain it from local water bodies, e.g. rivers, for free. The wood needed for firing the kiln varies significantly from region to region but also due to the fact kilns have different capacities. Kamonyi, Kigina is the PU with highest transportation costs (1000Rwf for clay sufficient for one stove) while at Rulindo PU transportation costs only 43 Rwf. Only the PU in Rulindo has additional expenses which however lead to the highest of all direct costs of 1600 Rwf contrasted to the Nasho PU which has only 239 Rwf costs per stove.

4.2.3. Equipment

The availability of equipment in the six PU varies significantly. The majority of the items are provided by the project and it is often the case potters do not even know what the costs of different equipment are. For the most part, the potters know where they can obtain equipment from with the exception of moulds .All production units experience shortages of moulds and this also reduces their productivity since potters have to share them. For this item the project manager was contacted in order to provide information on the prices. The table below presents the type, average price and average number of items in a production unit.



Figure 7: Canarumwe mould and stove, Kanazi PU,Bugesera,23.04.2012

Type	Number of items	Cost/item
kiln	1	70 000
mould	4,33	60 083
inkogoto		
knife	3,67	362,5
board	47	2000
tent	1,67	7375
pot rests mould	0,5	
umuhini		
hoe	2,17	1600
jelly can	2,17	1500
small bucket	2,67*	200
stones to make the sand		
table	2	16 500
shovel	1	1500
water tank	2*	8000
Sack	6*	300
sieve/1 meter	0,83	2000

Table 3: Average equipment availability

The cells indicated with * are equipment used at only one production unit, namely the one in Rulindo district.

Repair costs are unknown since the equipment has never been replaced or repaired. Only the kilns are repaired before firing the stoves. This includes adjusting the bricks of the kiln and filling the holes with some clay .No additional costs are incurred.

4.2.4. Production Process and Stove Variety

All production units produce Tekavuba and Canarumwe. Both Tekavuba and Canarumwe need approximately a month in dry season and a month and a half in rainy season to be ready for use. After the raw materials are transported to the PU, mixing of the clay can begin. It takes around an hour and a half to prepare the clay for moulding. The shaping of the stove in the mould takes up to 30 minutes for both models. After the stove is ready, it is taken out and placed on a wooden board where it stays until the next day when the pot rests can be added. Each pot rest takes 1 hour to be moulded and placed on the stove; therefore each stove requires 3 hours to obtain the three pot rests. Then the stoves are stored until the time they are ready to be fired. If it is rainy season, they are put in a tent or other covered place and kept there for 5 weeks. In dry season, the stoves can be put outside in the sun and are kept there for 3 weeks. The final stage is firing the stoves in the kiln. This is done for 24 hours to ensure the hardness of the stoves. After firing, 3 hours are necessary for the stoves to cool down and be removed out of the kiln. The installation into a kitchen takes 2 hours. Both stoves weigh approximately 10kg.

The numbers of stoves which survive the firing depends on the clay preparation. All stones and other particles must be removed to ensure the high durability of the stoves. Some PUs have the practice of selling even cracked stoves but at a lower price. The kiln capacity and usual number of cracked stoves are presented in the table below. The numbers in the table are combinations of both models since potters were unable to say the exact number for each model.

Average Kiln Capacity and Number of Cracked Stoves during Firing

PU	kiln capacity	Nº of cracked stoves
Bugesera,Kanazi	120	10 or 20*
Bugesera,Mayange	120	10
Kirehe,Nasho	120	4**
Kamonyi,Runda	95	9
Rulindo,Base	120	25 or 30
Nyamabuye,Gitarama	130	40
Min	95	4
Max	130	40
Average	117,5	17,50

Table 4:Kiln Capacity and Cracked Stoves

* not all cracked stoves are thrown away,the ones still good for use are sold at reduced price

**this is the number of completely unusable stoves

The preferred model is Tekavuba because it can support large pots. However, some users prefer Canarumwe due to the fact it has a base and therefore the firewood does not dig the floor while cooking. There is an acute shortage of moulds in each of the visited production units which reduces the production capacity.

Potters cannot reach an agreement if the stoves can burn crop residue.

4.2.5. Finance

Potters are members of cooperatives and everyone is supposed to contribute some sum of money in order to participate. When some stoves are sold, money is put aside so the production activities can continue. Nevertheless, there is no strict amount of money that has to be saved for the cooperative due to the sporadic character of sales.

4.2.6 .Enterprise Organization and Core activities

Although there is at least one production unit in each district,its activities do not generate enough revenues. Therefore, potters do not depend only on making ICS for income generation because it cannot sustain them. All the potters have to cultivate land to contribute to their income. Majority of the potters are organized in cooperatives; five production units out of the six are cooperatives. All the production units have no contacts with retailers because the project used to be the large client and the partner; and after the project finished, demand became a problem because there was no one to buy their products as recognized and permanent retailer.

4.2.7. Partners

The only partners to the PUs are different projects that act as their main trainers, financial support and also clients. There were different partners in different production units like Millennium Villages project and Practical Action but the dominant one is Practical Action which intervened in Kirehe, Kamonyi and Rulindo.

4.2.8. Quality Standards

The quality of the stoves is ensured by knocking on the stoves to hear the sound, firing them for 24 hours, when removed from the kiln without a crack, its appearance and sometimes by pouring cold water when the stove is still hot.

4.2.9. Maintenance Services

There is no guarantee or repair provided once the stoves are sold. Potters are generally willing to replace a stove if it breaks before it is installed. However, if it is installed and breaks a new one has to be bought. So far no client has made a claim for a broken stove.

4.2.10 .Most Frequently Stated Problems

Most of the production units face the problems of low demand, small or no storing place, high transportation costs and a need for marketing promotion.

4.2.11. Discussion

Having in mind the above mentioned observations, it seems several improvements can be made.

First, the production of ICS should be undertaken by entrepreneurs who have financial capacity. It is an advantage that potters are already trained and equipment is provided. What is more government is favorable of such initiatives and will facilitate the process of establishing an enterprise. Due to these reasons the investment needed for starting up a business venture is reduced. What is still needed is the purchase of more equipment and employing personnel that deals with market development and connections. These should ensure that retailers will sell the stoves at rural markets on regular basis and under agreed formalized conditions. It would be appropriate to contact people who trade with household utensils (e.g. basins, jelly cans, cooking pots) for a cooking stove also belongs to this category. Some of them have already been noticed to make efforts in this direction and what is more they can be viewed by household members as reliable and trustworthy when recommending the product and explaining the benefits it brings.

To boost the demand for ICS, their appearance on markets will not be enough. More aggressive promotion strategies are needed such as for example demonstrations in villages, more radio programs devoted to stoves and forest authorities' stress on the importance of its use.

Yet another possibility is to focus on the mud stoves which are already quite popular in rural areas. They have the advantage of being a product families are familiar with. This approach could be particularly successful for areas where people are generally old fashioned and are reluctant to embrace innovation. Since the efficiency rates of these stoves are not well known, there is still room for intervention from the private sector. What can be is an improvement in insulation terms by volcano stones, for instance. This approach, however, still needs to be tested in real cooking conditions (personal communications, manager of Enedom, company specializing in ICS production).

4.3. Households overview

The household survey aimed at confirming the information provided by previous studies in the field and possibly to deepen the insight into the biomass and improved cook stove use in rural areas of the country. Table 5 summarizes the characteristics of the sample.

HH sample

District	No households	Average Years of Education	Gender		Average No of family members	Income (Ubudehe)			
			Male	Female		1	2	3	4
Kirehe	14	4.5	11	1	5	0	4	8	2
Kamonyi	12	3.1	11	1	5	1	1	7	3
Bugesera	12	4.4	7	5	5	1	4	5	2
Rulindo*	13	1.7	9	4	5	1	4	5	2
Total	51	3.4	40	11	5	3	13	25	9

Table 5: Sample Characteristics

*One of the income categories in the Rulindo sample is unknown

To ensure that the sample is as representative of the whole population as possible, respondents were chosen randomly. 12 families were interviewed in Bugesera district, 6 in Gitaramuka village in Mayange sector and 6 in Gakindo village, Rweru sector. In Kirehe 14 families were contacted, 8 in Muganza village in Kigina sector and 6 in village Kabigembe 1 in Nasho sector. In Kamonyi 12 households were visited, 9 households in Manyana and 3 in Buramba villages in Kayumbu sector. Also in Rulindo 12 families were visited – 6 in Amaharo and 6 in Kigarama villages in Murambi sector.

Education is measured as number of school years, where it is known that the first six years of schooling are primary school. The next six years are secondary education. Therefore, knowing the years at school of all respondents gives information of the educational level they have. 89.1% of Rwandan population have attended primary school while only a small fraction of 10.5% have also obtained a degree from secondary school institution. The sample of this study is characterized by an average school attendance of 3.4 years with only respondents with only 3 of them who have attended some classes of secondary school. No one in the sample have completed their secondary school education and 15 have never attended school. (General census of population and housing, 2002)

Mainly because of the 1994 genocide the populations of Rwanda consists of more women than men, approximately 4,249 M women compared to 3,789 M of men or a men-to-women national ratio of 91.3. Men from rural areas are known to migrate to cities in the hope of better jobs and therefore further decrease the ratio of men to women. (General census of population and housing, 2002). However, the predominant percentage of our sample families are headed by men due to the fact that usually they are the decision –making figure (Clancy, 2002). Therefore, their importance should not be overlooked. In this sample woman is the head of the family in 11 of the households. The average number of family members is 5. Families usually have unstable income which is difficult to state per month or simply refuse to reveal it. For this reason the income category (ubudehe) was taken as guidance (See table 6). These categories are developed by the

Ministry of Local Government in accordance with the assets of households such as cattle, land, and income. To give the reader a relative idea of the income for the groups used in the study a monthly income of 5 000 RWf corresponds to category 2, 10 000RWf is representative for category 3, between 30 000 to 200 000 Rwf can be attributed to category 4. Income for category 1 could not be calculated due to the fact all respondents from this category did not know their income. Sometimes people listed in different categories have the same monthly income. This is due to the fact other factors such as the possession of cattle, for instance, are also taken into account. The majority of Rwandan population falls into category 3, followed by category 2. Our sample consists of 3 households in category 1, 13 in category 2, 25 in category 3 and 9 in category 4. The low number of representatives of category 1 is due to the fact that they are few for the population as a whole and also were for the most part absent from the villages that were included in the study. The following table presents four of the categories which are namely the ones we use. Categories 5 and 6 are for affluent households which are not the interest of this research since it targets the rural poor and also because they are very few.

Income (Ubudehe) Definitions

Category of Poor	Translation	Characteristics
Umutindi/Umukene Nyakujya	poorest	They have to beg and have nothing; no clothes, no food, no shelter. Their children cannot go to school; they cannot afford medical care and have no farmland. They have shelter but no livestock and are always suffering.
Umutindi/Umukene	poorer	They do not have sufficient food but can work for others to survive; they dress poorly, have insufficient farmland and can hardly get medical care.
Umutindi/Umukene wifashije	poor	They have small and poor shelter, and a minimal harvest, their children can go to primary school, they can clothe themselves but with difficulty, they can hardly access medical care, but manage to have sufficient to eat and they have small ruminants.
Umukungu	surviving	They have excess harvest to sell and live stock; they can afford medical care, and have a little money. Their children can go to secondary school. They eat well, are neat, have a good house and a bicycle, and can engage others as labour.

Table 6: Income Categories (Source: Sam Joseph, Local Collective Action, 2005)

Limitation: Time

The research is conducted for four weeks. Having in mind the wide span of the study, this is a constraint. The implication of this is the small sample size for both market and HH observations, which also means that extrapolation to the whole Rwandan population, will not be applicable

Since the sample size (51 HH) is not large enough to be conclusive, it was conceived better to have open ended questions, thus leaving enough room for the respondents to provide information which would not have been elicited with a closed questions questionnaire. The first part of the questionnaire deals with the cooking habits, conditions and perceived advantages of ICS for both users and non users. The second one deals with the fuel type and consumption of households in rural areas.

4.3.1. Cooking Environment and Stove Use

Since an improved cook stove of the Canarumwe or Tekavuba type, which are the main focus of this study, are originally designed to be used indoors as fixed stoves, one of the purposes of the study was to find out the cooking habits and preferences of rural families in terms of cooking indoors versus outdoors cooking. The survey reveals that 16% (8 HH) responded in the affirmative when asked if they cook indoors. An equal percentage confirmed they cook inside in case of torrential rains in the rainy season. Out of the cases that usually cook indoors, 6% (3 families) use a separate room designated as a kitchen. 61% use a separate building as a kitchen. Nevertheless, it is worth noting that some of the HH that fall in the above mentioned categories also admit they cook outdoors if the weather allows for it.

The majority (82%) of the HH have only one stove, followed by 16% who have two stoves. Only one of the interviewed families had many different stoves spanning from rondereza, charcoal stoves to biogas installation. The pie chart below presents the variety of stoves utilized by families. 63 % of the interviewed families still use 3 stone fire exclusively, while 14 % are currently using some model of an improved stove (Tekavuba, Canamake or self built which we will refer to as Rondereza) together with the traditional fire. The rest of the families (23%) rely only on an improved cook stove as a means for cooking: 12% use a self built Rondereza, 8% have purchased Canamake, which is a stove typical for Kamonyi district and is also produced by local potters like Canarumwe and Tekavuba. No family was found that uses Canarumwe and only one household in the sample has bought Tekavuba, which however had only two potrests (out of three) and was purchased for 1000 Rwf corresponding to only one third of the actual price.

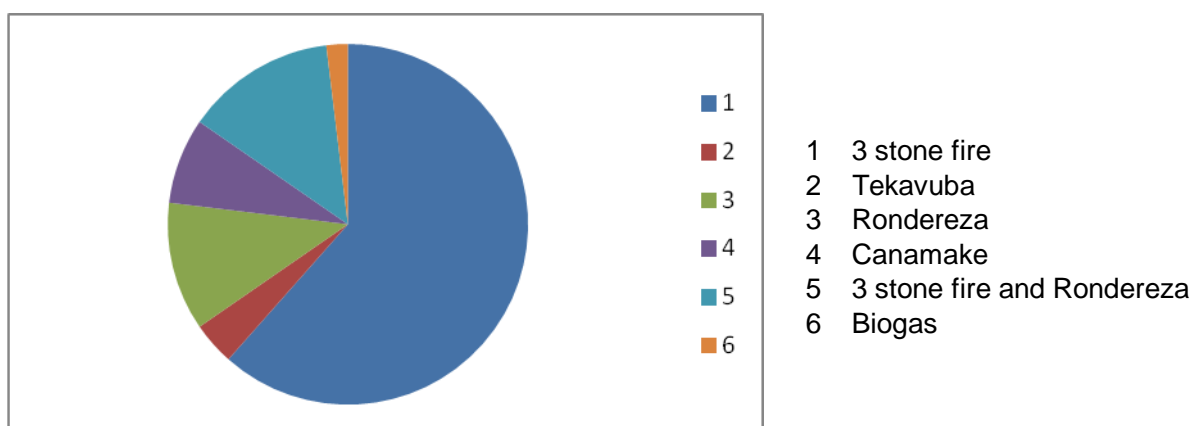


Figure 8 Stove use among households

Among the most frequently stated factors behind the still high numbers of families using 3 stone fire are: the only means known or available for cooking (33%), ICS high cost (24%) and the absence of a kitchen where an ICS can be fixed (24%). Individual responses are that ICS are cannot be found or that are not convenient to use. It turns out that a large number of ICS users dropped after the demolition of “grass” houses by a government project. The families were provided with iron sheets enough to build only a house and for the moment the majority cannot afford to construct a kitchen which is one of the main deterrents against ICS purchase (14%).

Among the most often reasons stated for combined use of 3 Stone fire and Rondereza are: cooking two meals at the same time, cooking outside the house (Rondereza is a fixed stove, therefore only 3 stone fire can be arranged outdoors) and the fact that Rondereza can not burn crop wastes.

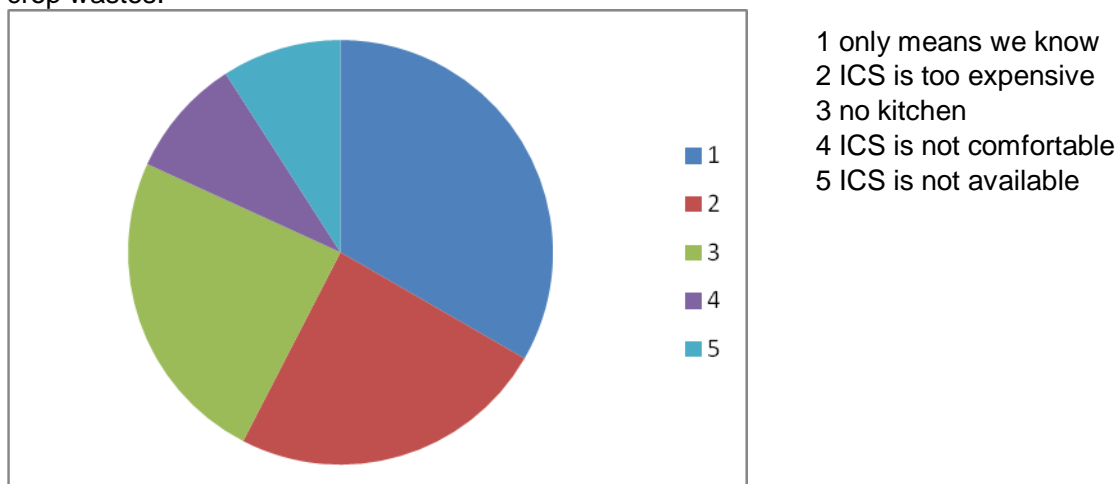


Figure 9: Reasons for using 3 Stone fire

ICS users were also asked if this is their first ICS. 79% confirmed, while 17% use their second improved stove already. Only one family had their 3rd ICS. The average period of time an ICS have been used is 4 years and 4 months. Usually these stoves have been obtained through a local campaign such as Millennium Villages or Zowa, self-built with the help of local trainers or school teachers educating pupils how to build Rondereza at home.

4.3.2. Position

Depending on the type of stove and convenience of use the models fall into two groups: fixed and portable. A 3 Stone fire is of course regarded as portable and for the most part an ICS is regarded as a fixed stove. Exception is Canamake which is designed as a portable stove. However, it is not uncommon to see an improved cook stove used as a portable stove. This is due either to the fact that installation costs extra money or simply out of convenience. Using Tekavuba or Canarumwe as a portable stove hides some risk of breakage and it is also possible that the fuel efficiency is reduced. In our sample 73% have a portable stove. This includes both 3 stone fire users and families with ICS which is not installed as a fixed stove (Tekavuba or Canamake).

4.3.2. Perception of ICS advantages over 3 Stone Fire

Both users and non-users were asked to identify the main advantages of ICS. At first, respondents had to point out the main advantages they see in using an ICS. 6 % responded that ICS cooks faster than a traditional fire. Individual responses also indicate that the kitchen hygiene is better and that airflow is reduced, thus not taking heat outside of the combustion chamber. Afterwards specific questions regarding the comfort of use, smoke reduction, taste of meals and fuel savings were asked. Table 6 represents the perception of different advantages of ICSs over traditional fire among our respondents. "Yes" designates the percentage of people who agree with a given criterion. "No" represents the people who do not find ICS to have the advantage in question. "To some extent" designates people who are less certain of the advantages, while "not applicable" corresponds to people who have not used ICS and do not know the advantages or simply do not have an opinion on some of the advantages listed below in particular. 63 % think

that ICS are comfortable to use as opposed to the opinion that stirring is not very convenient on a Rondereza stove. 77% recognize the fact that an ICS does save fuel and therefore reduces expenses or hours spent for gathering firewood. 39% of HH find no difference in the taste of meals cooked on an ICS. However, almost equal percentage (37%) says the smoke which 3 Stone fire makes, changes the taste of the food. 67% of respondents agree that ICS reduce the smoke while cooking. When asked under what conditions an improved stove has reduced smoke emission, respondents explain that the very design of an ICS reduces the airflow and therefore the heat and smoke are concentrated in the stove (28%). 26% say that a whole (chimney) in the stove channels the smoke outside.

Type of Advantage	Comfort	Fuel savings	Taste	Smoke
Yes	63%	76%	39%	69%
No	8%	2%	37%	2%
To some extent	2%	0%	0%	4%
Not applicable	27%	22%	24%	25%

Table 7: Perception of ICS advantages

4.3.3. Improved Cook Stoves Awareness

To further explain the use or not of improved cook stoves in rural Rwanda, the awareness of their existence was tested among respondents. To make a difference between a general knowledge of an improved cook stove referred to as "Rondereza" and actual product recognition of Canarumwe and Tekavuba, two categories were developed "general knowledge" and "product knowledge". 94% of respondents are familiar with improved cook stoves but only 22% know the new stoves. It is worth mentioning that even respondents who did not know the models by name but were able to describe them were counted as being familiar with the products.

4.3.4. Consumer Incentives, Preferences and Budget

The next section of the questionnaire evaluates the willingness to pay, market availability and incentives behind the purchase of an ICS. 35% of respondents expressed their interest in buying an ICS. A slightly higher number (37%) said they do not plan to invest in a new stove. 10% were not sure, while 6% confirmed they will buy an ICS once they build their new kitchens. Nevertheless, even if there is a demand for Improved cook stoves it turns out that consumers do not know where to find them (61%). Only 18% knew that stoves can be purchased directly from the production unit and knew where the production unit is located. 8% out of these have bought an improved cook stove from there before. 30% of respondents said they would not buy an ICS because of its high price which is surprising having in mind only 20% thought they knew the price when in reality only 12% knew the actual price of Tekavuba and Canarumwe.

Limitation : Willingness to Pay

Asking respondents directly what their willingness to pay for an item is can be unreliable for two reasons. First, respondents do not know the products and even though their advantages are pointed out, a substantial risk of inaccuracy in answering remains. Second, generally people have the tendency to understate or overstate the money value they are able and willing to give up. Thus, WTP can be used for providing some information on consumers' attitudes in situations when indeed little is known, .e.g. there is no formal market for a particular good, in this case firewood ICS. Nevertheless, further research must be conducted as well. (Lee, 2005)

The willingness to pay for an ICS varies greatly among households, ranging from 0 Rwf to 8000 Rwf (See figure 10). 18% of respondents were willing to pay the current price of ICS – 3000 Rwf, while only 14 % can afford to pay more. The figure below shows the average willingness to pay per category. It is curious to see that the households in income category 1 are actually willing to spend more than the ones in category 2 which are slightly better off.

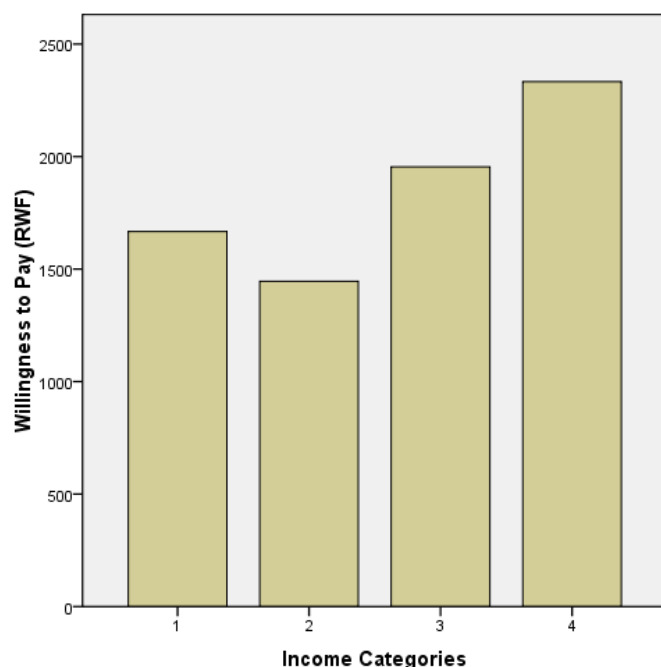


Figure 10: Willingness to pay for an ICS among different income groups

To facilitate the purchase of an ICS where there are serious budget constraints a proposal about paying in installments was made. 49% of households said that this would indeed help them obtain an improved cook stove. 30% however still remain reluctant due to unstable income and high possibility to be unable to pay next month's installments even if currently able to make the first one.

To find out the consumer preferences regarding different models and functions of improved stoves, respondents were asked to imagine that budget is not an issue and they can afford any type of ICS. However, due to the fact the product knowledge was very low among families it was very difficult for them to point out which model they would like to buy. What respondents could identify was the main reasons to buy an improved cook stove. The main incentives are fuel savings (35 %) followed by a combination of fuel saving and smoke reduction (33%). Individual responses are "government recommendations" or "ICSs cook faster".

4.3.5. Cooking habits

In this section the usual number and time of meals in households are investigated. All respondents in our sample have lunch and dinner, provided they have financial or physical means to buy food and fuel. Only two households prepare breakfast and this is usually porridge for the small children. The majority of school children come back home for lunch, with only 8% eating at school. The usual number of people for whom meals are prepared is the actual number of people in the household.

4.3.6. Fuel Types and Consumption

It is well known that rural Rwanda is primarily fueled by firewood (Nungo, 2012). This was confirmed by our findings (see Table 8) 39% of households rely exclusively on firewood for energy, while 57% use both firewood and crop residue (cassava, maize among the most common ones). There are some regional specifics such as the case of Rweru sector in Bugesera district, for instance, where papyrus from the nearby lake is heavily used for cooking. The primary source for firewood is forests. 53% of the interviewed households say they gather wood from everywhere. This means that the wood comes from private, government, public plantations. However, it is worth noting that people are allowed to gather wood (except for the private plantations) if they do not cut trees. 14% of households have their own tree plots but even some of them cannot rely exclusively on them for firewood supply. Therefore the domestic firewood need is supplemented by either gathering from elsewhere or purchasing firewood. 28% of families have their own trees. 10% indicated that they do have trees but are still very young or very few. Only 9% of households can satisfy their firewood needs with their own trees. A mere 4% always buy their firewood.

Firewood	Firewood and Crop Residue	Other fuels	Gather only	Purchase only	Gather and Purchase	Own Field
39%	57%	4%	53%	6%	24%	14%

Table 8: Fire wood Use and Origin

24 % both gather and buy wood from the market. Out of them only 6% have budget specifically for firewood purchase (2000 Rwf or 5000 Rwf per month). The rest buy it occasionally and therefore do not put money aside specifically for it. 55% dry their firewood but only 35% of them actually cover it. This is a common trend observed also at the interviews with firewood sellers – firewood is very often dried uncovered.

As already mentioned, the majority of sampled households gathers the fire wood needed for cooking. 37 respondents were able to give a rough estimation of the time spent gathering firewood. As a common denominator the fire wood used for one day, which corresponds to preparation of two meals was taken. The average time spent is 4,2 hours, with a minimum of 0.5 hours (only people with own tree plots) and maximum of 12 hours. Among people without own tree resources the minimum time required is 3 hours.

4.3.7. Environmental Affinity and Health Care

The last section of the household questionnaire focuses on the environmental awareness of the population and their concern over negative health impacts of smoke emission. To evaluate the environmental awareness of households questions concerning the relationship between water supply, soil fertility and forest cover were asked. 61 % knew the importance of forest for at least one of these indicators. Also, 51% of households recognize the reduced forest exploitation due to higher efficiency of ICS. In terms of health care smoke related diseases were investigated. 100% of households admit that indoor cooking produces a lot of smoke, the majority of them (88 %) also say they observe certain negative impacts on health with the most often stated being respiratory (24%) and sight problems (33%).

4.3.8. Discussion

Some households are used to cooking indoors and in these cases that Canarumwe and Tekavuba can be met with unwillingness to use. Indeed, the only family that was found to use Tekavuba had not installed it into a kitchen. Women prefer cooking outside, except for the case of heavy raining during the two rainy seasons. If we look at these finding from a cultural perspective, then convincing people to buy and install these ICS can be difficult. Nevertheless, the reason for these preferences can be the smoke emission. In this case the advantages of the stoves can motivate a purchase. Considerable fraction of the women, however, state they would like to have a new kitchen. This means that the phenomenon is not cultural but rather a matter of convenience. This is additionally strengthened by the fact that people have the practice of cooking in a separate building, thus the family is spared the bad effects of smoke. Therefore, better understanding of the advantages may lead to higher adoption levels. On the other hand, it is possible that the husband as the decision-making figure in the household might be reluctant to invest in an item which mainly benefits his wife.

It is also possible that the purchase of ICS does not eliminate the use of 3 stone fire. The use of both traditional and improved ways allows women to cook several dishes at the same time. Constructing a stove for more than one pot means buying more than one stoves and installing them together. This doubles the price of the product and is highly improbable to happen at a market segment where the purchase of even one stove is expensive already.

The fact households see the traditional fire as only means known for cooking comes to show that even though general awareness of ICS is high there still room for improvement on information and promotion levels. This is complimented by the finding that prices of ICS are considered too high. This means that the advantages of ICS do not outweigh their price. Another reason for this can be the availability of donor programs which people expect to provide efficient devices for reduced or no price. The argument that market for fire wood ICS is not present is additionally reinforced by the statement households do not know where they can find ICS.

An aspect to which authorities should pay attention is the harmonization of different policies and programs for rural areas. The iron sheet provision initiative, with all its benefits, creates severe difficulties for the ICS dissemination efforts.

There is a high awareness of the advantages which ICSs have over traditional fire in terms of both reduction of fuel consumption, reduction of smoke emissions. Some respondents even indicate taste improvement as a result of the reduced amount of smoke. Even though population is familiar with the concept of better combustion, few people seem to have heard of Canarumwe and Tekavuba. This can be attributed to several factors. To begin with, the products are new (1 year since the launch of the program) and it is normal to take some time before they become widely known. In addition, advertising and promotion must be enhanced. It turns out that the majority of people who know and buy the new stoves are potters' neighbors. The rest of the rural population very seldom knows the stoves. The majority of respondents who were aware of the new models existence had heard about them on the radio. Therefore, it could be a reasonable idea to continue broadcasting programs about ICS.

Interesting fact is people expect ICS to have a high price and indicate it as one of the main reasons for not buying a more efficient stove. Again, this could be the result of many programs supplying the stoves. As in the case of iron sheets which are very expensive and were provided by the government, people probably expect that others items donated by charity organizations are also costly and this is exactly why these items are given for free. At the same time the willingness to pay among respondent interested in the stoves is substantially lower than the price of the stoves. There are two main reasons for this. The first one is the expectation that at some point a stove will be given as a gift and therefore money can be spent on something else. The second problem is low incomes. In large families where the monthly income is 10 000 Rwf, spending 3000 Rwf on a stove means deprivation of other essentials such as food, clothing or

school fees, for instance. For this reason, paying in installments or providing some form of micro-financing can be a solution for large fraction of the population.

The high percentage of people relying on fire wood is not surprising for rural areas. Anyway, the argument that the reduction in biomass use motivates people to start using ICS might not hold. The budget spent on biomass will certainly be reduced but at the same time households buying fire wood are rare. The gains in spare time, on the other hand, do not seem to create an incentive big enough for families to sacrifice such a large proportion of their incomes. At the same time even rural rich families have a low WTP sometimes because they have their own plots of trees which are enough to satisfy their own fire wood needs. This is further confirmed by the finding that even though people have good understanding of the importance of forest, they still do not place such an importance on reducing their own impact. This is due to the fact they have other priorities to take care of first. Some might argue that important observation is the low availability of ICS but at the same time households have the knowledge of constructing mud stoves with greater efficiencies and still many of them prefer to use a 3 stone fire.

4.4. Market ICS

4.4.1 Overview

The market for improved cook stoves exists practically only for charcoal stoves which are predominantly used in the peri - urban and urban areas. The market for fire wood improved stoves is less formal. The firewood stoves are brought to the market by the producers themselves and not on a regular basis. Tekavuba and Canarumwe were found only at a market in Nyamata town, sold by only one seller who was selling households good such as basins, pots and washing powder. The seller herself was not informed about the products and did not even know their names but explains clients prefer Tekavuba (referring to it “as the big one”) because it is big and can support a big saucepan. The qualities and lifetime of the products were also not known to the seller but she assured the quality is very high. She was just expecting the “producer” to bring 15 stoves to the market the coming days. The producer was also unknown to her. As main customers she pointed households. Table 9 below presents the price at which she buys and resells the different types of stoves.

Type of stove	Producer price	Consumer price
Charcoal stoves		
Sudire (tin)		2 500 Rwf
Amavuba(clay/tin)		1 500 Rwf
Firewood stoves		
Tekavuba	800-1000	1 500
Canarumwe	800-1000	1 200

Table 9: Prices of improved cook stoves



Figure 11: Amavuba and Sudire Charcoal stoves

The cook stove sellers trade only with charcoal cook stoves because they are mainly in cities or at other big markets where there is neither demand for firewood stoves nor supply to the market. The lack of demand the sellers explain with the lower price for charcoal in comparison to firewood. The metal (tin) and clay charcoal stoves are brought to the market by a producer. The models made of both tin the seller buys from Kigali. The main clients are households. There is no guarantee provided to customers concerning the quality of the stoves. The seller is willing to engage in the ICS sector if stoves are available and producers agree to get paid after the stoves are sold.

4.4.2. Discussion

As already pointed out, the study was conducted for a relatively short period of time and had three separate focus areas which additionally restricted the time devoted to each of its sections. However, a number of markets were visited in different regions and only two ICS sellers were found. The finding itself comes to emphasize the low market penetration of ICS. Where there is some market supply it is thanks to the erratic efforts of artisans themselves to push their production to market places. These connections are, however, not formalized and supplies are not organized on a regular basis. Sellers themselves face high uncertainty in terms of obtaining the products and offer them for sale, which additionally deters them from engaging into the ICS market.

Sellers do not know the names of the products which implies they probably have a vague idea of the advantages of the stoves, as well. This only comes to illustrate the fragile connections with producers and also brings up the question why sellers agree to risk with products they know little about.

4.5. Fire wood and Charcoal Market Evaluation

4.5.1. General Overview

Interviews were conducted in the four different districts which the current study is interested in, namely Bugesera, Kirehe, Kamonyi and Rulindo. Eleven fire wood sellers were contacted, 1 in Bugesera and Rulindo, 2 in Kamonyi and the remaining 7 in Kirehe. Four of these also trade with charcoal, and one interviewee specializes entirely in charcoal sales.

4.5.2. Product Procurement

Firewood

The majority of the respondents (7) claim it is not problematic to obtain fire wood for sale. Two of them expressed their concern and pointed out that some amounts are available but limited. Other two (both from Kirehe) believe that fire wood is difficult to obtain. Only 2 of the sellers gather themselves, and only 1 has own forest.

It is quite unusual for a fire wood seller to dry the wood. Common practice is to buy it already dried. The majority of fire wood sellers do not have transportation costs since the gatherers come directly to them. Exceptions are the people who buy trees. The price they pay for a vehicle is between 3000 and 5000 Rwf.

People, who sell only small bundles at the markets and do not have premises, do not pay taxes. Sellers who have shops are obliged to pay between 20 000 and 30 000 Rwf per year. Sometimes cleaning costs of 1 000 Rwf per month are mentioned but the sellers do not know what these are for. These taxes apply for the whole shop and cover all goods, not only fire wood or charcoal. The average amount of wood that is stored is 11 bundles with an average weight of 30kg. (See table 10 and 11)

For the most part, the fire wood sellers obtain it by buying big trees and cutting them into smaller pieces or by buying bundles from people who gather. The average price of a tree is 11250Rwf and of a bundle is 519 Rwf. The average weight is 71, 33 kg and 28 kg for trees and bundles, respectively. Usually, out of one tree approximately 6 bundles are made. Bundles are sometimes resold without being divided into smaller ones. In the interviews taken only on one occasion the seller is reselling smaller bundles.

Charcoal

Two of the respondents believe charcoal is difficult to obtain. However, it is worth noting they do not find the biomass availability to be the problem but rather high prices or few suppliers with permits.

What is interesting is the fact there are no formal connections with any charcoal producer and sellers work with high uncertainty as to whether they will get charcoal at all. This is also one of the main reasons why they trade with other goods as well.

The average weight of a sack with charcoal is 50 to 60 kg for the eucalyptus one and 30kg for the avocado charcoal. Usually the charcoal sellers have a gain of 500Rwf per sack. It is resold either as a sack or in small buckets for the households. The average price for a bucket is 250 Rwf, where a bucket weighs around 1.5 kg. There are no transportation costs since the charcoal is transported to the sellers. Only one of the sellers has his own premises. The rest pay rent which is around 15000 per month. The average amount that is stored is 10 sacks of charcoal (See tables 12 and 13).

4.5.3. Enterprise and Financing

The fire wood and charcoal sellers usually do not participate in local cooperatives or have joined them after starting the business and often for other reasons. To finance their enterprise, the fire wood sellers had saved some money and some of them have also taken a bank loan from the rural bank Sacco. They usually work alone or are supported by family members when the work load increases.

4.5.4. Core Activities and Revenues

The sellers usually have other items at their store or stand and these are most often vegetables (tomatoes, potatoes, cassava), items for the households (jelly cans, basins) or cosmetics and cigarettes, among others. The fire wood sellers also often cultivate land and have animals.

4.5.5. Partners

Fire wood and charcoal sellers do not have partners to support them in their activities except for the bank Sacco.

4.5.6. Market Organization and Clients

The majority of the sellers work on both market and ordinary days and usually at the same market places and especially people who have their own shops. There is not a substantial difference in sales on market and ordinary days. Households are stated as main clients together with local restaurants. Some of the sellers are willing to bring fire wood to the clients instead of them coming to the market if they receive an order. Only one seller indicated that he charges more for this service than the price of the fire wood bundle. Charcoal is not delivered to household.

District	Sector, Cell, Village	Unit	Cost(Rwf)	weight (kg)	Unit for sale	Units per tree	weight (kg)	Price	Rent(per month)	Taxes(per year)	Cooking capacity*
Kirehe	Kigina, Ruhanga, Nyakarambi	tree	19 000	110	bundle	11	10	1500	6 000	30 000	6
Kirehe	Kigina, Rwaneru, Bugarura	tree	5 000	84	bundle	12	7	200	25 000	30 000	
Kirehe	Gahama	tree	20 000		bundle			500	17 000	20 000	4
Kirehe	Kabare, Ruhumba, Gakoma	tree	1 000	20	bundle	1	20	2 000			10
Average			11 250	71,33		6	12,33	1050	16 000	26 666	6,66
Min			1 000	20		1	7	200	6 000	20 000	4
Max			20 000	110		12	20	2000	25 000	30 000	10

Table 10: Fire wood quantities and prices of sellers buying trees and chopping them in bundles

*Designates number of meals cooked with one bundle

District	Sector, Cell, Village	Unit	Cost(Rwf)	weight (kg)	Unit for sale	weight (kg)	Price	Rent(per month)	Taxes(per year)	Cooking capacity*
Bugesera	Nyamata	bundle	0		bundle		700	0	0	1
Kirehe	Gatore, Nyamirango, Gashanga	bundle	0		bundle	3	200	0		1
Kirehe	Gatore, Nyamirango, Gashanga	bundle	1 400	40	bundle	40	2000	10 000	20 000	0
Kirehe	Ndego 2, Karambi, Gasenyi	bundle	0	30	bundle	30	1 500	0		10
Kirehe	Nasho, Rusirizi, Murindi	bundle	1 500	30	bundle	4	200	0		1
Rulindo	Base, Base	bundle	350	12	bundle		500	0		6
Kamonyi	Runda, Gihara, Kabasanza	bundle	400		bundle		500	6 000		1
Kamonyi	Runda, Kabasanza	bundle	500		bundle		600	15 000	30 000	1
Average			518,75	28		19,25	775	10 333*	25 000	2,63
Min			0	12		3	200	6 000	0	1
Max			1 500	40		40	2000	15 000	30 000	10

Table 11: Firewood quantities and price s

Charcoal

District	Sector, Cell, Village	Unit	Cost(Rwf)	weight (kg)	Unit for sale	weight (kg)	Price	Rent(per month)
Kirehe	Kigina, Ruhanga, Nyakarambi	sack	5700	50 -60	sack	50 -60	6 500	10 000
Rulindo	Base,Base	sack	4 000	50	sack	50	5000	0
		sack	2 500	30*	sack	30	3 500	0
Average			5200*	45		45	5 000	
Min			2 500	30		30	3 500	
Max			5 700	60		60	6 500	

Table 12: Consumer and retailer price of charcoal and the weights per sack

* designates avocado charcoal

District	Sector, Cell, Village	Unit	Cost(Rwf)	weight (kg)	Unit for sale	weight (kg)	Price	Rent(per month)	Cooking capacity
Kirehe	Kigina, Ruhanga, Nyakarambi	sack	5 700		bucket	0.5	100		
					bucket	1	200		
Kirehe	Gahama	sack	6 000		bucket	1	300	20 000	1
Kirehe	Gahama	sack	6 000		bucket	3	400		1
Kamonyi	Runda, Gihara, Kabasanza	sack	7 000		bucket		300	15 000	1
Average			6 333			1,67	260	17 500	1
Min			5 700			0.5	100	15 000	1
Max			7 000			3	400	20 000	1

Table 13: Consumer and retailer price of charcoal per sack and bucket

4.5. Forest Overview

By 2010 only 8.9% of forest ecosystems have survived in Rwanda compared to 30% cover in 1930 (Habiyaemye,2011). Since the country is currently experiencing very high levels of deforestation and an increased difficulties to cope with the diminishing forests ,the government of Rwanda has set the ambitious target of reaching 30 % forest cover and 50% reduction of wood consumption by year 2020 (Vision2020,2010).The Department of Forestry and Nature Conservation (DFNC) in Rwanda National Forestry Authority (NAFA) has selected different methods for combating deforestation in rural areas spanning from afforestation, reforestation and agro forestry to strict regulations as to how forests must be managed. Forests in Rwanda fall in several categories: government, district, sector (according to the administrative division) and public or private (according to ownership).Even private plantations are under regulations when it comes to tree cutting. When a large number of trees (an area above 1.5 ha) is to be cut a cutting permit is required and a forest official is in charge of deciding if the forest is mature enough.

Since the third objective of the current study is to find out what measures for forest conservation at institutional level are taken, some interviews with responsible government officials took place. In the districts of Rulindo, Bugesera, Kirehe and Kamonyi forest officials at sector level were contacted. They were asked specific questions on forest availability and forest management strategies in the areas delegated to them. At the DFNC, Director of Forestry Field Programs, discussed the forest issues at national level.

At sector level there is a general lack of information on fuel wood availability. Officials know the forest area but little is known for the actual fuel wood available for use. It is not uncommon that forest authorities are not aware of how much forest they are in charge of (table 10 presents the district and public forests as stated by the sector forest authorities). Naturally, this entails serious problems of policy implementation, monitoring and observing the rate of increase or decrease of forest cover. It is often combined with poor implementation of existing regulations as to when a tree is mature enough to be cut. Among different districts various minimum ages is applied, when actually the technicians have to evaluate if a tree is mature enough based on its appearance and not age. At NAFA, officials recognize these problems and explain that several new studies are under way to supplement the estimates on availability and consumption of previous research on the topic. There is also general awareness that personnel needs training since on many occasions it is the agronomist of the sector who is also in charge of the forest management. The DFNC is currently recruiting new forest professionals to meet its needs for qualified staff. In addition, an evaluation of possible higher education institutions outside Rwanda is being prepared where more people can attain qualifications. This was evoked by a previous study stating that the majority of forest related studies in Rwanda do not provide students with the practical know-how to apply to forest management (Baseline Studies for the National Forestry Development Plan 2009;2011).

District	Sector	Government forest (ha)	Private Forest (ha)	Forest Cover increase per year
Kirehe	Kigina	250		10ha
	Kigarama	203		12ha
	Nyamugari	160		12ha
Bugesera	Rweru	9.5	18	65 %
Rulindo	Murambi	NA	NA	NA
Kamonyi				

Table 14: Forest Cover per Sector

The dominant fuel in rural areas is fire wood - 86%, (Nungo,2012). The ambition of the government of Rwanda is to reduce this to 50%.The way forward is to adopt alternative fuels such as biogas or liquid petroleum gas (LPG).Nevertheless, DFNC recognizes that these are available only to a very small fraction of the population that is affluent enough to afford them. The main plausible option for rural families is the adoption of improved cook stoves in order to reduce the amount of wood burnt. In terms of charcoal production efficiency there is still room for improvement, too.

Firewood is often complemented with crop residues even though they have only seasonal importance. For the most part, forest authorities claim that crop residues are not essential for the household energy mix. According to them, crop wastes are mainly used as fertilizers or for feeding animals, which was not confirmed at our meetings with families in different districts. Therefore, it seems there is a general underestimation of crop wastes importance among forest officials.

In order to comply with Vision2020 targets and actually achieve them, the government of Rwanda has set a budget for seedlings planting. This budget is distributed to sector levels and used for reforestation. However, the number of planted trees and the original target sometimes are different. Sector authorities admit they have problems ensuring the number of seedlings previewed. This is due to the fact the DFNC now tries to plant in a concentrated manner. What is emphasized is the forest productivity and not so much the planted area itself. Since 92% of areas available for planting are private the main efforts are devoted to planting along rivers, roads and farms' borders. DFNC also gives priority to regions with very high levels of deforestation, especially in the eastern province. For instance, some people who were relocated to new areas which had to be deforested to create new living spaces. Therefore, the area which was abandoned was afforested in order to compensate for the loss of tree cover.

Since the households themselves are the ones who face the problems of fire wood decreasing availability on a day-to-day basis, it was interesting to find out that public discussion of this issue is not common in the country side. The most popular way to communicate to village dwellers the importance of the forest is by advocating the use of Rondereza, providing them with seedlings to plant on the border of their lands and instructing village authority to announce the decisions taken at district and sector level concerning forest matters.

Some forest plantations also belong to the private sector and it can be beneficial if the government and local authorities create some commercial incentives for them to be exploited. At the DFNC efforts are made for establishing a fund. The logic behind it is

that forestry is a sector with long term investment and therefore yields also come later. Banks, on the other hand, are interested and eager to finance projects with short term returns. Therefore, a fund created specifically for the needs and characteristics of the forestry sector will boost the economic activity with regards to private forests. Payments for ecosystem services are also an option which is discussed and currently being developed for implementation in Rwanda. At local level different practices are adopted to attract investors spanning from facilitating them when it comes down to cutting permits (Kirehe) to providing with seedlings when forest is growing old (Rulindo). Nevertheless, it is worth noting no unified practices are applied in this respect.

On the topic of illegal cutting and strict rules on permits, forest authorities at both local and national level are in favor of the existing system and claim the rate of unauthorized tree cutting is quite low exactly due to the fact the regulations are so stern. In defense of cutting permits, forest officials point out that they are enforced only at commercial level when a large territory is to be deforested.

4.6. Discussion on Biomass Market and Forest Conservation

The firewood found at markets come from plantations (where the trees are purchased from). This implies that the cutting of trees is regulated by the local sector or district authorities and therefore some control on deforestation is exercised. In the cases of bundles bought from locals and resold, it is common that the firewood sticks are gathered in forests. However, people are not forbidden from picking boughs fallen on the ground. Having in mind the penalties and the assurance of forest officials at sectors that illegal deforestation seldom takes place, we can assume that indeed bundles supplied to markets are not the result of illegal actions.

The charcoal market is characterized by the absence of formal connections and contracts between producers and retailers.

Both firewood and charcoal sellers do not appear to be concerned about low biomass availability. This only comes to show people are not fully aware of the high deforestation rates of the country. Further explanation can be that the wood material comes from private plantations which have certain rights of exploiting their own property even though they are also a subject of restriction.

The low levels of awareness can be partly explained by the severe lack of forest professionals at the corresponding agencies. For this reason, local authorities fail to understand and communicate the issues to local communities.

As the ICS sector needs a push towards formalized relations between producers and sellers, the same holds for the biomass market as well, and especially the charcoal distribution. This can allow for more transparency of transactions and will facilitate the monitoring for illegal cutting by easing the way to identify if a producer that approaches retailers has a permit for production.

Monitoring is needed for the cover increase as well. The approach of planting as many seedlings as possible without having a clear idea of survival rates cannot be reliable. Post evaluation of tree planting is nevertheless very difficult in Rwanda because of its scattered plots of free spaces on different location which means more human and capital resource will be necessary.

Chapter 6: Conclusions

Even though Rwanda is characterized by a high rate of ICS adoption and use, it turns out the market for ICS is not well developed and only charcoal stoves can be occasionally found at market places. This becomes evident by both the ICS market evaluation and the households visits. Despite the fact, a number of markets in 4 different districts were visited, ICS for sale were not found. On the rare occasions when charcoal stoves sellers were present at markets it was confirmed they are not familiar with Canarumwe and Tekavuba or other fire wood improved stoves. In communication with households it became evident consumers do not know where they can find ICS with the exception of people living close to a production unit or knowing some of the potters working there. This can be the consequence of the fact production units have not established contacts with retailers and have so far relied almost entirely on project campaigns to both provide them with equipment and buy their production. The potters themselves lack knowledge of business, entrepreneurship and trade. If there is any future continuation of the campaign these areas should be emphasized. In addition, marketing and promotion needs to be enhanced in order to reach more rural families. So far, the product awareness of people is fairly low. Another common issue is the high price of the moulds which is unaffordable to PU if financial assistance is withdrawn. Currently there is a shortage of moulds experienced in all visited PUs and workers take turns to use them which slows down the productivity of the PUs. Some PUs are also confronted with high numbers of cracked stoves while the firing takes place. The reason for this can be that the clay is not prepared sufficiently well, with lots of stones remaining inside. This can be easily prevented with the use of sieves which were found in only one PU.

The household evaluation revealed that indeed a large proportion of the population utilize Rondereza which has efficiency gains over traditional fire. However, ICS that are purchased and not self constructed are rare. What is more, the new models -Tekavuba and Canarumwe, are not known to consumers. Only one Tekavuba was found in the whole sample, while Canarumwe was absolutely absent. This can be attributed to several facts. First, the sample size is not very large and second, the products are quite new and it will take time until they are widely adopted. This process can be accelerated by promotion and demonstrations in villages.

At the same time it is curious to observe that rural communities do have trouble obtaining their fire wood. This would imply they will more actively search for solutions to alleviate this problem, especially given the fact people do realize ICS use leads to less forest exploitation. However, the average willingness to pay for ICS is well below the current price and this holds for all four income categories. The negative health impacts of 3 Stone fire smoke also do not seem to become an incentive for ICS adoption. Either the advantages of the new stoves need to be stressed at a future promotion campaign or their production costs need to be reduced.

On the wood fuels market there seems to be an underestimation of the biomass availability crisis. Another specific feature is that sellers do not have formal contacts with gatherers or producers. Partly for that reason, many of them trade with different goods in order to ensure their income.

In terms of forest recovery, it seems the situation is going to improve, having in mind local authorities claim forest cover is increasing. However, there are still issues that need to be overcome such as personnel training, increasing the number of people engaged in forestry and securing good education for future forest professionals.

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Annex B Questionnaires

Production Unit Questionnaire

Raw materials

1. What type of raw materials do you use?
2. Where do you get your raw materials (clay, sand) from?
3. Is it easy to obtain them? (availability, distance)
4. How much is the price for each type of product?
5. Is the quality good?
6. How do you transport the materials?
7. How much does it cost to transport them?
8. What other costs do you have?

Equipment

9. What moulds/kilns/other equipment do you use?
10. How often do you have to replace them?
11. What are their costs?
12. What are the maintenance costs for the equipment?
13. Is it easy to obtain the equipment? (availability, distance)

Production Process & Stove Variety

14. Can you describe/show the whole production process?
15. Do you use wood fuel for firing the stoves?
16. If yes, where do you get this fuel from? If no, what fuel do you use?
17. What type of stoves do you make?
18. How much time does it take to produce one stove?
19. How many stoves survive the firing? (For each model respectively)
20. How many stoves can be produced in this production unit per day?
21. How many stoves of each type do you produce?
22. Which one sells the most?
23. Can you say why? (Lowest price, convenience of use)
24. Can the ICS (each type) burn crop residue?
25. What is the lifetime of ICS (for each type respectively)?

Enterprise organization and activities

26. Do you and your family depend only on this activity for income?
27. If no, what other activities contribute to the household income?
28. Is this a family business /cooperative/enterprise?
29. Is making ICS your main/only activity?
30. What other activities do you participate in to increase your income?
31. Is this your business or you are hired by someone?
32. How much do you earn? (turn over if it is the owner, salary if it is a worker)
33. What type of workers work here? (potters, accountants, managers)
34. How many workers work here? (for each position respectively)
35. How much do you pay the workers? (for each position respectively)
36. How much time do you work per week? (the whole unit and workers)

Market

37. Where is the closest market?
38. When is it open? (which days)
39. Do you sell the ICS only in this area?
If no, where else?
40. Who are your clients? (HH living close by, wholesalers)
41. Do your clients come here for ICS especially?
42. How do you sell them? (Districts, wholesaler)
43. Do you go to them or they come to you?
44. How do you transport the ICS?
45. What is the price per stove (for each type of stove)? (market price)

Quality Standards

- 46. How do you ensure the quality of your stoves?
- 47. Do you have a person responsible for quality control?
- 48. Does RBS recognize your enterprise? (Rwanda Bureau of Standards)
- 49. Do you have a RBS certificate?
- 50. Do you have a trade mark?

Partners

- 51. Who is your partner/supporter?
- 52. What kind of support do you receive from these partners?(financial, training, material procurement)

Financing

- 53. How do you finance your enterprise? (loan, ibibina, tantin, cooperative)

Maintenance Services

- 54. Do you give a guarantee for your products?
- 55. Do you provide maintenance and repair if needed after the ICS are purchased by the clients?

Market ICS

Product procurement

- 1. Is ICS available here for doing business?
- 2. Where and from whom do you obtain the ICS you sell?
- 3. What is the cost of ICS?
- 4. What is the transportation cost?
- 5. What other costs do you have?
- 6. How many ICS do you store?

Enterprise organization & Financing

- 7. How is your enterprise organized/structured? (family business, company, cooperative)
- 8. How many people work with you?
- 9. What are their positions/responsibilities?
- 10. What do they earn as wages?
- 11. How do you finance your business?(loan, lbibina, tantin, cooperative)

Core Activities and Revenues

- 12. Is ICS your only/main business?
- 13. If not, why?
- 14. What other activities contribute to your revenues?
- 15. What is the price of ICS (for each type respectively)?
- 16. How many ICs do you sell per week/month?
- 17. What is your daily/monthly revenue for all activities?
- 18. If you sell different models of stoves, which ones sold the most?

Partners

19. Who supports you in getting ICS for sale?
20. What kind of support do you receive from them?
21. Who supports you in selling ICS?
22. What kind of support do you receive from them?

Market Organization & Clients

23. Which are the market days?
24. Do you sell on other days as well?(different from the market days)
25. How many days per month do you sell ICS?
26. Is this the only market where you sell ICS at?
27. If no, where else?
28. Do you go to other markets because you have large clients there?
29. Do you always bring ICS to the market for sale?
30. If no, why? (few clients, market is far, hard to obtain ICS)
31. How many ICS do you bring to the market every time?
32. Who are your main clients?
33. Is it possible that you sell directly to your clients instead of them coming to the market?

Maintenance Services & Marketing

35. What is the lifetime of ICS (for each type respectively)?
36. Do you give a guarantee for your products?
37. Do you provide maintenance and repair if needed after the ICS are purchased by the clients?
38. Do you have an idea of the advantages of ICS?
39. Do you communicate this to the clients?
40. Do you try to make publicity for ICS? How?

If no ICS retailers are to be found on the market which is very likely to be the case:

41. Are you willing to engage in the ICS sector?
42. Under what conditions would you be willing to sell ICS together with the other items you have in store? (Price, transportation from the PU, contracts with PU)
43. Are you willing to include village promoters in the marketing program given that they receive the 500 Rwf for installation?
44. Are you interested in investing in ICS production and afterwards selling the stoves?
45. For what market price will you be interested in engaging in such a project?

Market Fire Wood**Product procurement**

1. Is fire wood/charcoal available for doing business?
2. Where and from whom do you obtain the wood/charcoal you sell?

-
3. Do you burn or dry the wood/charcoal yourself or you buy it from someone?
 4. Where do you dry/burn them?
 5. What is the cost of wood/charcoal per unit?
 6. What are your transportation costs?
 7. What other costs do you have? (e.g. rent for premises)
 8. Do you own or hire the premises you use?
 9. How much wood/charcoal do you store?

Enterprise organization & Financing

10. How is your business organized/structured?(family, company, cooperative)
11. How many people work with you?
12. What are their positions/responsibilities?
13. What do they get paid as wages?
14. How do you finance your business? (loan, tantin, ibibina, cooperative)

Core Activities & Revenues

15. Is fire wood/charcoal your main/only business?
16. If not, what are the other commodities you sell?
17. What other activities contribute to your revenues?
18. At what price do you sell wood/ charcoal per measurement unit?
19. How much fire wood/charcoal do you sell per month?
20. If you sell both fire wood and charcoal, how much is the contribution of any of these to your income?
21. What taxes do you pay? To whom?
22. What profit do you have left after paying taxes?

Partners

23. Who supports you in getting the fire wood/charcoal?
24. What kind of support do you receive from them?
25. Who supports you in selling the wood/charcoal?
26. What kind of support do you receive from them?

Market Organization & Clients

27. Which are the market days?
28. How many people sell firewood/charcoal?
29. Do you sell on other days as well?(different from the market days)
30. How many days per month do you sell fire wood/charcoal?
31. How much do you sell on a market/normal day?
32. Is this the only market where you sell wood/charcoal?
33. If no, where else?
34. Do you go to other markets because you have important clients there?
35. Do you always bring fire wood/charcoal to the market for sale?
36. If not, why? (few clients, market is far, hard to obtain firewood/charcoal)
37. How much wood/charcoal do you bring to the market every time?
38. Who are your main clients?
39. Is it possible that you sell directly to your clients instead of them coming to the market?
40. How many times per day can be cooked with 1 measurement unit of wood/charcoal?

Forest Management

-
1. Do you have data on the wood availability in your sector?
 2. How large is the forest you are responsible for and what is the rate of deforestation?
 3. Do you know what percentage of the forest is government forest, sector forest, private or public forest?
 4. What is the importance of crop residue in the fuel mix in your sector?
 5. How do you plan to contribute to achieving the Vision 2020 target of 30% forest cover?
 6. How can community discussion solve the problem of deforestation?
 7. Do you try to create incentives for forest plantation owners to invest in this sector?
 8. Do you have an approximation of the rate of illegal tree cutting?
 9. Do strict permit regulations create room for illegal cutting?

*At some occasions where it was appropriate for the specific situation additional questions were asked. These is specified in the interview and an answer to a question which is not listed above is marked with an *.

Annex C ICS Market

Bugesera, Nyamata market

Interview 1

Seller claims Tekavuba and Canarumwe are not produced at the moment but she is waiting for the producer to bring to her 15 stoves on Wednesday. The producer is unknown to the seller. Since the interview was carried out at Nyamata town market, the majority of clients prefer the charcoal stoves. There is however a small demand for Tekavuba and Canarumwe models (the seller does not know their names and refers to them as the "big" and "small" one). Tekavuba is the preferred model since it is bigger. The lifetime of the stoves is unknown to the seller but claims their quality is high.

The salesperson has capacity for storing 10 stoves. The counter sells all sorts of items for the home-basins, cooking pots, washing powder.

The market day is on Wednesday, but the seller is there every day. Clients are households.

Interview 2

The seller trades only with charcoal cook stoves because there is neither demand for firewood stoves nor supply to the market. The lack of demand the seller explains with the lower price for charcoal in comparison to firewood. The seller has a permanent stand at this market which is open every day (the market day is Wednesday). The only item sold at the stand is charcoal stoves. The metal (tin) and clay charcoal stoves are brought to the market by a producer. The models made of both tin the seller buys from Kigali. The main clients are households. There is no guarantee provided to customers concerning the quality of the stoves. The seller is willing to engage in the ICS sector if there is stoves are available and if producers agree to get paid after the stoves are sold. The stand is the seller's own business and is financed with a bank loan, 7000 Rwf per month.

Type of stove	Producer price	Consumer price
Charcoal stoves		
Sudire (tin)		2 500 Rwf
Amavuba(clay/tin)		1 500 Rwf

Annex D Production Units

1.Bugesera, Nyamata ,Kanazi, Nyarugatsi

Raw materials

The materials used for ICS production (both Canarumwe and Tekavuba) are clay and potter sand. In order to obtain these materials a permit from District authority is issued and then the potters are free to collect clay and potter sand from public sites. However, when asked if it is easy to obtain raw materials, the workers point out the long distances from raw material site to production unit as a big obstacle. This entails a cost of 600 Rwf per stove for corresponding amount of clay transported to PU paid to a person engaged in transportation exclusively. The quality of the materials is good according to the potters. Other production related costs arise in order to fire the kiln. Therefore, 1000 Rwf per bundle of firewood is incurred. 30 bundles burn one kiln. From a swamp nearby the potters also cut grasses, dry them and use them for the top of the kiln after the stoves are ready to be fired. The grasses accelerate the firing. Also water is needed for mixing the clay. 1 jelly can of water is 10 Rwf and 10 jelly cans are used for 40 or 50 stoves.

Equipment

The table below shows the equipment used, number per item and price (if available).

equipment	price	number of equipment
Kiln		1
Mould	60 000	2
Board		10
Table		2
hammer		1
Tent	8 000	1
Basin	500	1
Knife	200	2
potrests		2
jelly cans	1500	2



Canarumwe mould and stove, Kanazi PU, Bugesera, 23.04.2012

The costs and frequency of replacement or repair are unknown since the equipment has never been replaced /repaired. There is a necessity for purchasing new moulds. Currently the PU has only one mould per ICS model (Canarumwe and Tekavuba). Only the kiln is repaired before firing the stoves if there are holes in the wall. This is done by adjusting the bricks of the kiln, filling the holes with clay to ensure the proper firing of the stoves. There are no additional costs due to this repair work. Moulds, tables and pot rests cannot be easily found on the market. However, the potters know to make their own pot rests. The rest of the equipment is found on the market. The kiln capacity is 120 stoves.



The kiln of Kanazi PU. (Photo taken: 23.04.2012)

Production Process and Stove Variety

The PU produces both Canarumwe and Tekavuba. It takes approximately 1 month in dry season and a month and a half in rainy season for a stove to become ready for use. The number of stoves that survive the firing depends on the clay preparation – if there are stones left after mixing the clay, the stoves crack. The daily capacity of the PU is 7

stoves per person. The total amount of workers is 7 (initially 15 were trained, but have abandoned the enterprise). This however is only under condition the materials are already collected and transported to the PU and work can begin. The working days are 6 per week. Between 10 and 20 stoves are cracked in the kiln. This is an acceptable level of lost production, no financial losses. The ones still good for use are sold at a lower price (1000 or 1500Rwf). The unusable ones are thrown away. Tekavuba sells more because cooks faster, can utilize big sauce pan and is sold for the same price as Canarumwe. Therefore, it is also the model produced more and is easier to mould. Both models are to be used with firewood. Correspondents claim the stoves cannot burn crop residue. After intervention from Project representative (Millennium Villages), they change their mind and say that if the residue is dried it can be used as well. The lifetime of both Canarumwe and Tekavuba is 20 years.

Enterprise Organization and Activities

The workers at this PU depend on pottery and land cultivation for a living. After the project started they included the production of ICS in their product variety. The business is organized as an independent enterprise and is owned by the workers themselves. It is not a cooperative. A potter's wage depends on the number of stoves produced (which is limited due to the low number of moulds- 1 per model).

Market

Market days are Wednesday and Saturday. The closest market is Nyamata market. When asked who their main clients are, the potters responded that the project is the "market" and is responsible for finding clients. They try to find their clients on the market now that the project is over. However, no big retailer has been contacted. Currently they have 90 stoves in their store. The ready stoves are stored in the cell building.

Quality Standards

In order to ensure the quality of the stoves, the potters knock on them and evaluate if the stoves are of good quality. Other sign of high quality is the lack of cracks on the stoves and their general appearance. The mould size is the standardization measure. When the project was still going, there was a person exclusively responsible for quality control. Nowadays, no one is specifically responsible for that, all potters have to take care of it. When asked if the Rwanda Bureau of Standards recognize them as an enterprise, the potters respond that this is negotiated at a higher level (MINIFRA) and they themselves cannot know.

Partners

As partners or helpers are considered:

- Millennium Villages project (organizing the production and afterwards purchasing the stoves)
- Cell authority (storage of ICS and guarding them)

Maintenance Service

No guarantee is provided and no repairs are carried out on an ICS already bought. If the stoves break, a new one must be purchased.

Problems stated by potters

- No demand for ICS
- Publication (HH low awareness of ICS)
- Real price of ICS if no project is involved amount to 4000 Rwf
- Clay is obtained from a swamp 5 km away and each worker brings on their head the corresponding amount for 1 stove

The initial preparation needed to start the work would include: the raw materials procurement, finding market, providing living allowances during the waiting days (the time needed for the stove to become ready for use).

2. Production Unit Bugesera, Sector Mayange, Cell Kagenge

Raw Materials

Raw materials are potter sand and clay. The potters have authority justification for raw material procurement. The transportation cost (for clay) for 1 truck is 40 000 Rwf , 12 km away from PU(paid by the project). Motor vehicles are needed for transportation. Quality of raw materials is high. Other costs are made for firewood (25 000- 30 000 Rwf ,1 tonne, to burn one kiln,120 stoves) and water (20 Fwr for 20 litres for 20 stoves).Workers are paid 1000 Rwf to pick and mix the clay for the first three months the project was running.



Potter sand site at Mayange PU,23.04.2012

Equipment

The table below presents the number of equipment items and their prices.

equipment	price	number
kiln	70 000	1
mould	60 000	5
jelly can	1500	5
basin	700	5
boards		many
hoes	1800	2
tents	8000	3
machette	1000	2
knives	150	13

*Canarumwe -2 moulds, Tekavuba -3 moulds

Repair is done only on the kiln before firing. This includes filling holes with clay and adjusting bricks. All equipment is provided by the project (Millennium Village).

Production process and Stove Variety

Only dry firewood is used for firing the stoves because it produces less smoke. Smoke spoils the stoves. Both Canarumwe and Tekavuba are produced. It takes a month in the dry season and a month and a half in the rainy season for a stove to be ready for use (both models). The kiln capacity is 120 stoves, out of which 10 stoves crack. The production capacity of one person per day is 6 stoves. In total 13 potters work at this PU. They work 4 days per week. The number of produced stoves of each type depends on which moulds they decide to use. The demand for both models is the same. Both Canarumwe and Tekavuba can burn crop residue. The lifetime of the stoves is 20 years. Equal amount of stoves is made because the demand is the same. Price of stove is 2000 Rwf but the real price is 4000 RWf. Quantity of sold stoves is unknown. If the stove

breaks when it is still wet, they use the material for a new stove; if it is fired they throw it away.

Enterprise Organization and Core Activities

ICS production cannot sustain the potters on its own. In addition to his activity, workers also cultivate land. If the demand is high they can focus only on ICS production. The enterprise is organized as a cooperative (Copama) and the headquarters are at this PU. The members are not relatives. The cooperative has a president, vice president, secretary, auditor, accountant and these positions are all held by the potters. It is their own business. Half of the revenues remain for the cooperative so the production can continue.

Market

The main clients are the project and some households from the area. Customers express their interest in the ICS. Neighbors order stoves to be brought to them from the PU. To transport them from PU, the potters use bicycles or carry them on their heads. 1 person can bring up to 3 ICS with a bicycle. One truck can bring 30 ICS. The price per stove is 4000 Rwf for each model. Nevertheless, to neighbors it is sold for 2000Rwf. There is a problem with finding a retailer because at first the people around were given stoves for 500 Rwf, so now they cannot sell the stoves for 2000Rwf or even 4000 Rwf.

Finance

The cooperative members contribute money to buy clay or firewood. The rest is provided by the project.

Quality standards

To ensure the quality of the stoves the kiln is fired for 24 hours. If it is still whole after removal from the kiln, it means it is hard enough. Afterwards the general appearance of the stove and the sound it makes when knocking on it indicate its hardness. Another method is to spray some cold water on a still warm ICS. If it does not crack, then it is hard enough. During the project there was a person responsible for quality control. Currently, all potters are engaged in this. No one is particularly responsible. Once it is installed, a stove cannot be replaced with a new one. If a customer falls and cracks it, the potters consider it an accident and give a new one.

Partners

Millennium Villages project – constructed the kilns, provided the moulds and the rest of the equipment, transportation (a car from the project delivers the raw materials to PU) and training.

Maintenance Services

No guarantee or repair services are provided. So far, all sold stoves are in good condition.

3. Kamonyi ,Sector: Kagina,Cell: Kagina

Raw materials

The raw materials that are used are clay, insibo (potters sand) and water. The clay that is used is taken from along river Nyabarongo but because of its low quality, potters have to mix with another type of clay which is taken from around their places so that they can get good quality. None of the two types of clay can be used individually. They get sand (insibo) from Ruyenzi cell and water from Nyakagezi River. It is not easy to get these raw materials because to transport one truck of clay from Nyabarongo river costs 40 000 Rwf. 400 stoves can be made from this quantity of clay when mixed with second type of clay to improve the quality. They spend the whole day picking the clay from soil and when the project was running, each person was paid 1000 Rwf/day but because the project is no longer working the 1000 Rwf is not given.

The potters pay also 30 000 Rwf for firewood to fire the stoves. This firewood is obtained from an old wooden house which is demolished. This amount of firewood can be used two times to burn the kiln i.e. one kiln (95 stoves) can be burned by firewood equivalent to 15 000 Rwf.

Equipment

Equipments	Quantity	Price per unit (Rwf)
Moulds**	3	60 000
Kiln & store	1	30 000 for rent
Board	100	2 000
Basin*	10	
Jellycan*	4	
Tent*	2	7 000
Ishashi (plastic bag)*	1 roll	28 000
Shovel	5	1 500
Hoe	5	1 500
Table	1	18 000
Hammer	1	3 000
Knife	1	100
Pot rest mould	1	

*Broken equipment

** 2 Canarumwe and 1 Tekavuba moulds

The kiln is repaired before each firing of the stoves but there is no cost for the repair because the potters do it on their own. All the equipment was brought by the project and because the project is no longer working, once the equipment is broken there is neither repair nor replacement of the broken equipment.



Kiln used by Kamonyi PU. It is used for other purposes as well and is not specifically constructed of ICS firing.(photo:24.04.2012)



Pot rest mould and a pot rest already fired on a stove, Kamonyi Production unit, 24.04.2012

Production Process and Stove Variety

The time taken to produce one stove, starting by mixing clay and up to when the stove is ready to be cooked on, is one month (for both models and in both rainy and dry season). The kiln can have capacity of 95 stoves and the stoves which can be broken because of the firing vary between 8 and 10 and Tekavuba is easily broken. Because of the sharing of equipments, one person can make 5 stoves per day and 8 stoves if there is no sharing. In total 31 people work at this PU. They are organized in the following manner:

4 groups:

Monday - 1st group makes stoves

Tuesday - 2nd group makes stoves

Wednesday - 3rd group makes pot rests and doors (hole for the wood stick)

Thursday - 4th group makes pot rests

Friday - all potters come to prepare the clay for next week.

Canarumwe is mostly made because of more moulds(2) available compared to Tekavuba(1). The project preferred Canarumwe while the household prefer Tekavuba because it supports big pot/saucepan. These ICS cannot burn crop residues because crop residues emit a lot of smoke. The lifetime for these ICS is 5 years and above if

installed in the kitchen. Some people use them as portable stoves but then they break easily. All potters have a ICS installed at home.





Potters fixing a mould on a table and demonstrating how they shape the inside of a stove at Kamonyi PU (24.04.2012).



Potters demonstrating how doors are molded at a stove.(Kamonyi PU 24.04.2012)

Enterprise organization and Core Activities

These potters do not depend only on ICS but also make pots which are only taken to market to be sold, charcoal stoves and cultivate land. Before, the project was the main clients and few household. Nowadays, there is no market for ICS or to small extent households. The project came to their place to buy stoves even now if someone wants a

stove comes to their place. The price is 1800 Rwf large amounts are purchased like the project and 2050 Rwf per one stove purchased.



Charcoal stove produced at Kamonyi PU and sold at town markets

Quality Standards

The quality of ICS is good, and in fact better in comparison to charcoal stoves. There was a person in charge of quality control by the time the project was operating in the production unit.

Partners

The partner was *Practical Action* but now the production unit has no partners. The support that was given to the production unit was training and provision of materials.

Financing

Initially the project was financing the production unit (PU) but now the PU have to find other means for financing in order to buy some necessities e.g. firewood to burn the kiln.

Problems stated by the potters

- To find for them market and permanent place to sell their products
- Help them in getting their own kiln and store
- Help in getting materials
- Help in transportation of clay

4. Rulindo, Basi ,Rwamahwa, Kiruli

Raw materials

The materials used for ICs production are clay(obtained from Gatovu,5 km away from PU) and potter sand(collected from Mugenda,1km away from PU).Collecting materials is

not easy due to the distance and high transportation costs – 30 000 Rwf /truck. This is the amount needed to produce 700 stoves. In addition, two working days are necessary to pick and load the materials in the truck. Sand collecting takes 3 hours go-and-return for amount of 2 or 3 stoves per person. Except for transportation costs, the materials themselves do not cost anything. The clay site the cooperative exploits was given to them by the government. The sand site is private; sometimes they buy small treats (e.g. beer) to the owner to compensate him for the sand collected from him. The quality of the raw materials is good. Another cost is the firewood needed to fire the kiln – 50 000 Rwf. From the market to the PU the workers carry the firewood on their heads. Also, when some workers go to the market they are provided with daily allowances (500Rwf for food and 300 Rwf for transport one way). This allowance is sometimes given after the ICS are sold. The PU has a bank account. The rent is 8 000 Rwf/month for stores.

Equipment

Land and “tent” cover is owned by the potters. The pillars of the tent are given by the project and the land – by the government.

The table below shows the type, number and cost for equipment.

Equipment	Cost	Number of equipment
Kiln		
Mould	60 000	9
Inkogoto	0 many	
Knife	1000	5
Board	2000	100
Tent	6500	1
pot rests mould	1	1
Umuhini	0	5
Hoe	1500	6
jelly can	1500	2
small bucket	200	6
stones to make the sand	0	
Table	15 000	3
Shovel	1500	1
water tank	8000	2
Sack	300	6
sieve/1 meter	2000*	4*

Table : Equipment in Rulindo PU

These costs were unknown to the potters. The numbers were provided to us by the project representative.

*The cost of sieve is 2000Rwf per meter, out of one meter 4 sieves can be made and are used for 3 weeks each.

One water tank has capacity of 140 litres.

Repair costs

If a jelly can or a bucket or broken, the potters fix them themselves. The cost for one hole is around 100 Rwf. If a table needs fixing, the cost is 1700Rwf for replacing the

wood.5 basins were fixed for 2000Rwf in total (not by the potters themselves). Out of 10 basins 4, are still used. They were bought last August and used until February; therefore we can conclude the lifetime of one is approximately 7 months.

Availability

The availability of the equipment depends on the budget available for the PU. Except for the moulds everything else can be found on the market.

Enterprise organization and activities

They cannot depend on this activity only for income generation. All of them cultivate land. The enterprise is organized as a small cooperative and all members are relatives. The revenues are equally divided among the members.

Production and Stove Variety

Production process description

- 1 h and 30 min- mixing the clay before it is ready to be put into the mould
- 30 min to shape into the mould
- 1 day- waiting until the stove is ready for pot rests
- 1 hour – making the pot rests
- 3 hours – adjusting the pot rests on the stove
- 1 week (5 days if it sunny)- waiting before the stove can be fired
- 24 hours – in the kiln
- 3 hours – cooling down of the stoves
- 2 hours - installation into a kitchen

The whole process is 2 weeks (in rainy season 3 weeks and a few more days). When asked to compare with it other units where potters claim a month and a half in necessary, they respond it is possible.

Both Canarumwe and Tekaguva are produced. Out of 120 stoves 25 – 30 on average break in the kiln. The potters do not know why the stoves break. Of 10 are broken ,no loss but if more than this amount – a loss.

The PU has 23 members divided in 2 units:

1st unit: Monday – mix the clay

Tuesday – not working (cultivating land)

Wednesday – all members come and mould ICS (30 stoves in total)

Thursday - not working

2nd unit: Friday - put the pot rests

Saturday – not working (market day)

Sunday – not working (Christians)

They used to produce 15 Canarumwe and 15 Tekaguva stoves when they had the same number of moulds for both models .Now they produce 20 Canarumwe and 10 Tekaguva since they have only one mould for Tekaguva. Canarumwe is said to sell more because it has a base unlike Tekaguva, whose mould does not have a base and therefore it cannot be added. Both models are said to burn crop residue. The lifetime of the stoves is 5 years when it is installed. Installation is provided by the potters. When somebody buys a stove he/she leaves his/her address, makes an appointment and the potters go and install the stove into the kitchen. The installation price is 500 Rwf.

Other Comments

- Just upon our arrival the PU stuff understood that the project is over and they will not receive the 800 Rwf per stove they expected. Currently they sell at a price of 1000 Rwf per stove (both models).
- They have two pot rest moulds but use only one since the other is not authorized to be used.
- The PU has written rules and regulations. A lady from the project helped them with this.

Market

They only sell in this area and their clients are households. The price for both models is 1800 Rwf and the profit for them is 400 (the lady from the project calculated it). The people come to the market to buy ICS. They usually go to Gakenye (30 km away) and Rulindo (30km away). 10 people go to the bus station and each brings (on head) two stoves. Then they take minibuses to go to the market. All go in different buses to find available seats. The weight of 1 Canarumwe stove is 8kg, and Tekaguba is 7 kg. They go to the market once per week because of the high transportation costs. It is often the case that not even a single stove is sold or 2 out of 20.

They tried to contact some retailers through the project but the project contract ended before that. Currently, they are in the process of getting in touch with some retailers. First they have to communicate it to the cell authority and they are at this stage.

Quality standards

Quality is ensured by knocking on the stoves, its general appearance and if it comes out of the kiln uncracked. When the project was still on 3 people were responsible for quality. They do not know if Rwanda Bureau of Standards recognizes their enterprise.

Partners

EWASA- advisory, training, financial, equipment provision
1000 Rwf per person per day for the first 3 months the project was going

Maintenance

No guarantee for quality is provided. The potters say the stoves are so hard, one can even take it out of the kitchen installation and use it in another one (if they move to another house, for example). If somebody comes with a broken stove and it was not customer's fault they will replace.

Financing

The 20% of income goes to cooperation. Example: 15 000 Rwf revenue, 20% goes to cooperation (3000 Rwf), the rest distributed among cooperative members.

Problems as seen by the potters themselves:

- Market
- Clay transportation

Store (they actually have 2 stores) is too small (at the moment of interview 250 stoves, 50 green and 200 fired)

5. District: Kirehe Sector: Nasho Village: Gicaca

Raw materials

Raw materials are clay, potter sand and water. The materials are collected from a site 5 km away from the PU (Naruka). Obtaining the materials is not easy due to transportation. For the clay, the PU has bought a small patch of land and exploits it. The clay is carried on their heads and one person can carry the amount equivalent to two stoves, each person goes 6 times per day. They start at 6 a.m. and transport clay until 2 p.m. The quality of the raw materials is good. The water costs 10 000 RWf for 3 months and is taken from a tub close to the production unit. Other costs are the firewood and grasses bought to fire the kiln. 1 vehicle costs 80 000 Rwf and is enough to fire 3 kilns (1 kiln costs 26 666 Rwf). The grasses cost 2000 Rwf per kiln.

Equipment

The table below shows the type, number and cost for each equipment item and premises.

Equipment	Price	Number of equipment
kiln		1
mould	65 000	4*
tent		1
board		69
hammer		1
table		2
sieve		1
knife		1

Equipment and premises in Kirehe PU

*2 mould for each ICS model

No replacement costs are known since the equipment is not replaced. Only exception is the kiln, which needs a repair before each firing. However, this does not entail any costs. Only the bricks are readjusted and some mud is put in the holes to make the walls thick.

Production Process and Stove variety

Both Canarumwe and Tekavuba are produced. It takes 3 weeks in both rainy and dry season to produce one stove of each type. To estimate how many stoves survive the firing 4 categories are used:

1. Stoves with no cracks (Highest quality) – 100 stoves/kiln
2. Stoves with small cracks (no effect on stove performance) – 10 stoves/kiln
3. Stoves with big cracks (still can be used) - 5 stoves/kiln
4. No good – 4 stoves/kiln

The total capacity of the kiln is 120 stoves. The unusable stoves are just thrown away.

Due to low number of moulds the production is organized in 2 or 3 groups as follows:

- 1st group: collects and carries materials to production unit
- 2nd group: prepares and mixes the clay
- 3rd group: moulds/shapes the ICS

The whole unit can make up to 60 ICS per day. There are 19 members in the cooperative (10 women and 9 men). They work 5 days per week. The working day is

until 2p.m unless they have to put the pot rests. On these occasions they work until the evening.

Mainly Canarumwe is produced and only by men since it requires more force. Tekavuba is made by girls and elderly women. The two models cannot burn crop residue since it does not provide the heat needed for the combustion chamber and it also produces too much smoke. The price of both models is 2 500 Rwf with installation included. Canarumwe sells more because it keeps the ashes at its base and the fire does not dig the floor. The lifetime for both models is 10 years when installed in a kitchen.



Clay preparation at Kirehe PU 25.04.2012

Enterprise organization and Activities

This is not the only activity. Workers also cultivate land in order to make a living. They are organized in a cooperative (C.I.A.K.K.) with president, vice-president, accountant, secretary. All of these positions are held by the potters themselves. The enterprise is their own business. The revenues cannot be predicted. If they sell a stove, they share the money. If someone was absent at the production of the sold stove, they do not receive a share of the money. Some money is put aside for new equipment.

Market

The closest market is Murindi (8 km away). They do not have a stand there. The market days are Tuesday and Friday. They do not sell ICS only in this area. Some Households come to PU to buy stoves.

Quality standards

To ensure the quality of the stoves, they are fired for 24 hours. Another method is knocking on the stoves. When the project was ongoing there was a person responsible for quality control. The potters express their desire that the assistant they had from the project comes back and helps them again.

Partners

Practical action - all materials, equipment, training, assistant/leader.

Maintenance

No guarantee or repair is provided. A broken ICS will be replaced if it was not customer's fault but only before installation; afterwards a new stove has to be purchased if it breaks.

Problems as seen by the potters:

- Financial support to build a store (at the moment they hire from a neighbor)
- New equipment is necessary (especially two wheel barrows to transport materials)
- Market needs to be developed
- Transportation is the major problem, households are aware of the existence of ICS
- The PU had orders to bring ICS to other areas but they failed due to high transportation costs;
- The PU is still operating even though the project is over but it generates money only to make both ends meet

6. District: Muhanga, Sector: Nyamabuye, Cell: Gitarama, Village: Nyarutovu

Raw materials

The materials that are used in making ICS are: clay and potters sand (insibo). The clay is from Kabgayi area and sand is from Nyarutovu. It is difficult to get these raw materials because the sand is bought (1 small parcel is bought for 15000 Rwf) and to get money is a problem; clay is not bought but transport is a problem because one person takes 4 hours to and fro carrying the clay on head which can make only 2 stoves. The quality is good. Other expenses they have are the money to buy the firewood to fire the kiln.

Equipment

Equipment	Quantity	Price per unit (Rwf)**
Mould*	2	
Kiln & store	1 kiln & 1 store	
Hammer	1	
Tent	2	
Ishashi (plastic bag)	1 roll	
Board	9	

*broken

** They don't know the prices because the materials were brought to them by the project.

Production process and stove variety

The stove can take one month to be ready to be cooked on during rainy season and 3 weeks during dry season. The kiln hosts 130 stoves both Canarumwe and Tekavuba and approximately 40 stoves break during firing. Canarumwe is mostly demanded by the clients because it has a base. These ICS do not burn crop residues and their life time is 7 years when installed or fixed in the kitchen.

Enterprise Organization and Activities

The potters do not depend only on making ICS because they do not have permanent demand. They also cultivate land and have animals. The potters are organized in a cooperative. They are 18 people in the cooperative, divided into 2 units.

1st unit work from Monday to Wednesday and this unit make 20 ICS per day.

2nd unit work from Thursday to Saturday and they also make 20 ICS per day. The price of the stove was 2000 Rwf plus 500 Rwf for installation. The household pay 1500 Rwf and the rest were paid by the project.

Quality control

No one in charge of quality, they look at the stove and decide if it is good; and if it is fired for 24 hours, means that the stove is hard enough. They test also the quality by knocking on it and hear the sound.

Partners

The partner was *Practical Action* but now the production unit has no partners. The support that was given to the production unit was training and provision of materials.

Finance

They finance themselves, when they have sold the ICS some money go the cooperative and share the rest.

Maintenance Services

No guarantee or repair services are provided. So far, all sold stoves are in good condition.

Problems and needs stated by the potters:

- Help in getting market
- Help to get new materials because others were broken
- Help them in transportation of both raw materials and products
- Get people to advise or coordinate them.

7. Practical Action Advisor in Kirehe PU

The advisor is one of the 15 people especially trained by EWSA. These advisors were closely working with the PUs for 10 months, 8h per working day. Their monthly salary is US \$ 750 .

They are in charge of training, marketing, quality control, initiating partnership with NGOs and government. Marketing includes publication, promotion and negotiations with local leaders. The advisors also ensure the funding of the projects and explain that the project will continue when new funds are available. These funds can be both from government or organizations willing to contribute.

Annex E Fire wood and Charcoal Market

1. Bugesera, Nyamata

Product procurement

The firewood sellers do not cooperate among themselves. All of them collect and sell individually. Firewood is available but in small amounts. The nearest forest is 16 km away. Firewood is not dried or stored by the sellers. The wood is taken from the forest directly to the market. One bundle sells for 700Rwf. The price is negotiable with a minimum price of 600Rwf. There are no transportation costs since the gatherer also carry the bundles by themselves to the market.

Core Activities and Revenues

Gatherer does not engage in other activities. One person brings to the market 1 bundle per day every day. It takes 6 hours. Nyamata market is the only one gatherer sell at. Firewood sellers are not taxed and are not prosecuted by the law for exploiting the forest. If the branches are fallen off the tree people are allowed to take them. A bundle is enough to cook beans three times on a 3 stone fire.

2. Rulindo, Base, Base

Product procurement

Both fire wood and charcoal are available for doing business. Actually, demand is less than what the seller has to offer. Once a month he buys bundles, and apart from that he has a small forest (2.5ha). He can afford to cut 10 trees (eucalyptus) per week out of his own land and explains that if the top of the tree is dry no cutting permit is required. Out of one tree between 10 and 20 bundles can be made. The approximate weight of the bundle is 12 kg. The price at which he obtains a bundle is 350 Rwf and then resells for 500 Rwf. He dries the fire wood.

The charcoal he always buys. 10 sacks get sold for one week. An eucalyptus sack weighs around 50 kg. He buys it for 4000 Rwf per sack and resells for 5000Rwf. 1 avocado sack is 30 kg and sells for 3500 Rwf. It is bought from producers for 2 500Rwf. For both the fire wood and charcoal there are no formal contracts with providers and no formal retailing system. The producers come sporadically to sell to the “retailers”.

Associated costs are the wages for people who carry the bundles and this is 600Rwf per day per person. The taxes he pays are : 30 000 Rwf per year patent 3 000 per month to the district.

The store is owned by the seller.

Enterprise Organization and Financing

It is a family business. The people engaged in it are the seller and his carrier. It was started with own finances.

Core Activities and Revenues

Selling wood and charcoal is not the only income generating activity for the seller. He also cultivates land and has animals. The seller refused to reveal his monthly revenues from charcoal and firewood.

Partners

The seller has no business partners.

Market Organization and Clients

The shop is open every day regardless of the market days. The usual numbers of charcoal sacks sold varies. On a market day it can be up to 4 and on an ordinary day it is possible that not a single one is sold. The usual number of fire wood bundles sold per week is 20. He sells at this market only. The usual clients are restaurants for the fire wood and urban dwellers for the charcoal. The clients come to him, he does not work with orders. Sometimes he fails to get charcoal because of the absence of formal connections with the producers.

1 bundle of firewood can cook two times, 3 kg of beans.

Problems stated by the seller

- Money to expand the business
- Transportation means

3. Kamonyi, Runda, Gihara, Kabasanza

Product Procurement

The seller buys from local people who gather in the surrounding area and bring the bundles to the market. She buys one bundle for 400 Rwf and then resells for 500 Rwf. The seller does not trade with charcoal. There are no transportation costs since the bundles are brought directly to the market. Associated costs are the rent for the shop which is 6 000 Rwf per month. The amount of wood that can be stored is equivalent to 3 000 Rwf (60 bundles).

The maximum turn over would be around 4 000 Rwf per month if she abandons the vegetables in order to store more fire wood.

Enterprise Organization and Financing

It is own business. Her child sometimes helps her. Except for that no partners are involved. To start the business a benefactor gave her 10 000 Rwf as a gift.

Core Activities and Revenues

In the shop vegetables and spices are sold together with the firewood. This is the only income generating activity she has. The monthly turnover from fire wood sales is 3000 Rwf.

Market Organization and Clients

The shop is open 7 days per week. The clients are households and restaurants. All fire wood gatherers come to her and then she resells. If they go directly to her clients she will lose the market.

2 bundles can cook 1kg beans on a 3 stone fire. (The bundles are made of solid wood not just branches.)

The bundles come from big trees that are cut into smaller pieces. This can come from both government plantation and private plantation.

4. Kamonyi, Runda, Kabasanza

Product Procurement

Both fire wood and charcoal are available for business. The fire wood is brought to the market by local people. The charcoal is transported with a truck from Kikongoro.

1 bundle of fire wood is sold for 600 Rwf. It is bought by the seller for 500 Rwf. 1 sack of charcoal is 7 000 Rwf and is then resold for 300 Rwf per bucket. 1 sacks equals 25 buckets. Associated costs are the rent for the premises which is 15 000 Rwf/month. 30 000 Rwf per year are paid in taxes.

Enterprise Organization and Financing

It is family business run by two people only. To start up the business a bank loan was withdrawn which is still being paid. Other items for sale are vegetables.

Market Organization and Clients

The shop is open every day. It takes two days before one sack of charcoal is finished. 5 bundles of firewood are sold per day. The main clients are households.

1 bundle of firewood cooks 1kg of beans once

1 bucket of charcoal cooks 1 kg beans once

5. Kirehe, Gatore, Nyamirango, Gashanga village

Product Procurement

Fire wood is always available for sale. Local people bring it to the market and sell to him. He trades with big (40 kg) bundles and small (3kg) ones. The big one is bought for 1 400 Rwf and then is sold for 2000 Rwf. The absolute minimum price would be 1 800 Rwf but not lower than this. The smaller ones cost 200 Rwf and they come from the big ones which can be divided into small and sold individually.

Other costs are the premises rent which is 10 000 Rwf/month and taxes- 20 000 rwf/year. This tax is for all the items he sells: food, cosmetics, and cigarettes among others. He can store the equivalent of 30 000 Rwf. In dry season however the demand is lower and therefore only fire wood for 20 000 Rwf is stored for sale.

Enterprise Organization and Financing

The shop is own, family business. The seller and his wife take turns to work behind the counter. To start up the business own financing was combined with a bank loan (150 000 Rwf) from the rural bank Saco (20 000 Rwf/month has to be paid). They sell fire wood thanks to the fact they also have other items.

Core activities and Revenues

Their monthly income from fire wood only is 15 000 Rwf net profit.

Market Organization and Clients

The market day is Wednesday. The shop is open every day. The main clients are households. For the most part the clients come to the shop. However, sometimes the seller does orders. The price is the same regardless of the fact he transports the firewood to the clients' homes.

1 bundle is not enough to cook 1kg of beans on a 3 stone fire.

6. Kirehe, Kigina, Ruhanga, Nyakarambi

Product Procurement

Wood and charcoal are difficult to get due to the fact the price is high. Therefore, the seller's price also has to be higher and clients are sometimes discouraged to buy. The seller buys a big tree for 18 000 – 20 000 Rwf and then chops it into smaller pieces. Out of one tree 11 bundles can be made. Each bundle weighs approximately 10kg and sells

for 1500 Rwf. The charcoal is bought in sacks. One sack is 50 -60 kg and cost 5 500 – 6000Rwf to the retailer. Then he sells the sack for 6500 Rwf or charges 100 per small bucket (550 g) and 200 per big bucket (1 100g). There are no transportation costs. Nevertheless, wages are paid to people who load and unload the trucks with the trees. It costs 10 000 Rwf to load and unload a vehicles. The rent for the premises is 6 000 Rwf. A maximum of 10 sacks are stored and the bundles that come from 1 tree. The taxes are 30 000 Rwf /month.

Enterprise Organization and Financing

It is own business. It is financed with own money. 10 sacks are sold per month. The sales of fire wood are occasional and therefore cannot be estimated.

Core Activities

The seller also sells vegetables for sale (onion, potatoes, cassava, spices, and tomatoes).

Market Organization and Clients

Market days are Tuesday and Friday. The shop is open 6 days/week. The main clients are households. Usually, the clients come to the market but sometimes the seller also takes an order and brings it to the household. For these services she charges a little bit more than just the price of the bundle .The charge depends on the amount of firewood and distance.

Example: 500 Rwf for 3 km for 50kg

A bundle for 1500 Rwf is enough to cook beans twice per day for 3 days. The equivalent of 1000 Rwf charcoal cooks beans for 2 days.

7.Kirehe, Kigina, Rwaneru, Buganura

Product Procurement

Fire wood is easy to obtain. It can be either gathered in a public forest or bought from a private one. 1 tree costs 5 000 Rwf and 10 -15 bundles come out of it. A bundle is 7kg and sells for 200 Rwf. At holidays when children do not go to school and can help their households gather wood, the price goes down to 100 Rwf due to the decrease in demand. There are transportation costs- 3000 Rwf per tree. Taxes are 30 000 Rwf /year. For storage the seller used to pay 15 000/ month but it is now being demolished. The new one will cost 25 000 /month but it is a lot larger. Since she has other items too, the seller cannot say how much wood she can have in her store.

Enterprise Organization and Financing

She contributes 1000 Rwf per week to a cooperative. When she is short of cash the cooperative supports her. Apart from the wood she also sells vegetables: onion, tomatoes which she grows herself. Her monthly net revenue is 6000 Rwf .

Partners

The seller says she will go to Saco (rural bank) if she decides to expand her business.

Market Organization and Clients

She works 7 days per week and only at this market. However, she does not have fire wood for sale only two days per week because the availability is low. The total value of all her items is 10 000 Rwf. Clients are restaurants and households. They come to her. She does not transport wood to families.

1 bundle can cook 1kg of beans on a 3 stone fire

8. Kirehe, Gahama

Product procurement

Charcoal is not easy to get. The seller explains he buys the charcoal only from producers with permits and they are few. 1 sack costs 6 000 Rwf and then is sold in buckets per 300 Rwf/1kg.

There are no transportation costs but the rent is 20 000 Rwf /month. Taxes are 20 000 Rwf. There are also cleaning tax which is 1000 Rwf /month.

Enterprise Organization and Financing

It is own business. Two people work at the shop, the seller and his wife. The business was financed with own money.

Partners

Ibibina – a local cooperative organization. He pays 8 200 Rwf per month contribution. He joined the ibibina after starting the business.

Core activities and Revenues

The seller also cultivates land and has some animals. Other items he sells is everything for the home. The net turnover is 30 000 Rwf per month .

Market Organization and Clients

Market days are Tuesday and Friday. The shop is open 6 days per week. Clients are households. The clients come themselves.

1 bucket of charcoal can cook 1 kg of beans on a charcoal stove.

9. Kirehe, Gahama

Product Procurement

Both firewood and charcoal are not so easily available for doing business. They are expensive. For the firewood, a big tree is bought and chopped into small bundles. The charcoal is brought on a bicycle. One tree costs 20 000 Rwf and to cut it is additional 15 000 Rwf. Transportation is 5 000 Rwf. Taxes are 20 000Rwf /year and there are also cleaning costs of 1000 Rwf/month. The trees are bought from different people and there is no formal connection to any provider. Charcoal costs 6000 Rwf/sack. Then it is sold in buckets (3kg) for 400 Rwf per bucket.

1 bundle sells for 500Rwf. The rent for the premises is 17 000 /month. There are no transportation costs. She can store one big tree and two sacks of charcoal. She buys a new tree or sack only after selling the previous one.

Enterprise Organization and Financing

It is own business. Family members might help occasionally (seller's son). The seller does not know her profit but explains it is enough to pay the school fees, buy new stock and live. The financing comes from a bank (opportunity bank). The loan is 100 000 Rwf. She pays 7 000 Rwf per week. In four months the loan is paid back.

Core Activities and Revenues

The shop is the only source of income for the family. She sells rice, biscuits, cassava flour, soda, tomatoes, and pineapples. She explains is too risky to trade with one item only.

Partners

The bank is their only help concerning the business.

Market Organization and Clients

Market days are Tuesday and Friday. The shop is open 7 days/week. 3 sacks of charcoal are sold per month. Fire wood is not always available for sale. Clients are the households but she points out there are no regular customers. Clients come to her shop; she does not bring charcoal or wood to homes. 1 bucket can cook 1 kg of beans on a charcoal stove. The remaining amount is enough to cook bananas. 1 bundle cooks 1kg beans two days twice with ICS and twice on a 3 stone fire.

10. Kirehe, Nasho, Rusirizi, Murindi

Product procurement

Fire wood is available. The seller obtains it from people who bring large bundles to the market. The seller does not dry the fire wood. The price of a bundle is 1 500Rwf and it weighs around 30kg. The bundle is divided into smaller ones (4kg) and sold for 200 Rwf each. There are no other (for premises, taxes or transportation) costs. The seller can store between 7 and 10 large bundles (30 kg).

Enterprise Organization and Financing

It is own business. The seller works on her own. She used her own money to start up the business.

Core activities and Revenues

Selling fire wood is not the only activity. Also vegetables (cassava, tomatoes) are available at the stand. The seller sells 90 big (40 kg) per month.

Partners

The seller's husband sometimes supports her financially.

Market Organization and Clients

Market days are Tuesday and Friday. Around 4 people trade with small bundles. The number of sold bundles does not depend if it is a market or ordinary day. The seller always has fire wood at her stand. She buys 3 big bundles per day and divides them into smaller ones. The main clients are households. The seller does not transport fire wood to the clients.

1 bundle cooks once on a rondereza

11. Kirehe, Nasho, Kabare, Ruhumba, Gakoma

Product procurement

Fire wood is available but not in very large amounts. The seller buys a tree and cuts into smaller pieces. He does not dry the trees. 1 tree costs 1000 Rwf and is approximately 20 kg. The bundle sells for 2 000 Rwf. He brings such amount to the market 3 times per day. There are no transportation costs, since the seller uses his bike. There are no other

costs; he cuts the trees himself and there are no taxes. He does not have any premises. The maximum amount he can store is 1 tree.

Enterprise Organization and Financing

It is own business. He works alone. The business was financed with own means.

Core activities and Revenues

Apart from firewood, the seller also cultivates land. 72 bundles are sold per month (6 days per week/3 bundles per day/4 weeks per month).

Market Organization and Clients

The market days are Tuesday and Friday. 30 and above people sell fire wood. The seller comes to the market every day (except Sundays). He sells 3 bundles per day regardless of the fact it is a market or ordinary day. He does not sell at other markets. Main clients are households and restaurants.

1 bundle can cook 7 days on rondereza

12. Kirehe, Nasho, Ndego 2, Karambi, Gasenyi

Product procurement

Fire wood is easy to obtain. Sometimes it comes from Akagera National Park. If the gets caught he pays 500 Rwf to get away with a penalty. The seller does not dry the wood. There are no taxes or transportation costs. The seller does not have premises. He can store up to 3 bundles of 30 kg each. The price of the bundle is 1 500 Rwf.

Enterprise Organization and Financing

It is his own business. He works alone. The business was started up with own finances.

Core Activities and Revenues

Selling for wood is the only income generating activity for the seller. He sells 24 bundles per month.

Market Organization and Clients

Market days are Tuesday and Friday. Above 30 people sell firewood. The seller sells 4 days per week. On a market days two bundles are sold and on an ordinary day only 1. Sometimes he offers the wood directly to households. The main clients are households.

1 bundle cooks one week 1 kg of beans twice a day on rondereza.

Annex F Forests

Rulindo, Murambi sector

1. *Here wood fuels come from private plantations (not sector forest), but the quantities are small. Also charcoal is produced and taken to the markets in Kigali.*

**What about the people who gather wood. Where this wood comes from?*

They go and gather everywhere, both private and public plantations.

**If wood gatherers just collect what has fallen on the ground already and do not cut trees, is there a fine for that?*

No, they can collect what has fallen on the ground.

2. *How large is the forest you are responsible for and what is the rate of deforestation?*

I do not know. This information can be obtained at a district level. However, the forest cover in Murambi is increasing not decreasing.

**How do you ensure the trees can grow at the current level of firewood production?*

A tree must be at least 7 years mature before we give a cutting permit. When somebody applies for a permit, we go to their forest and estimate if the tree is old enough to be cut.

3. *Do you know what percentage of the forest is government forest, sector forest, private or public forest?*

I do not know. This information can be obtained at a district level.

4. *Crop wastes are used but not extensively. Most of the crop residues are used for coffee fertilizers.*

5. *We try to mobilize people with land which is not suitable for crops, e.g. very steep hills where crops cannot grow to plant trees instead. Also trees are planted along land boundaries and rivers.*

**There some government and NGOs project which make terraces on hilly terrains, which then makes them appropriate for crop cultivating.*

Yes, but this is very expensive and very few people can afford it unless a project does it for the land owners. Another point is that some slopes cannot be terraced. We always mobilize people to plant trees in marginal areas and also to engage in agro-forestry.

6. *We discuss these issues with the village authorities which have the responsibility to communicate them at a village level. Also, after a study on ICS (rondereza) was conducted and indicated fuel efficiency of ICS in comparison to 3 stone fire, we advise communities to start using rondereza. This way they follow the example of fellow villagers who have already experienced the advantages of ICS.*

**Does a form of community forest management give motivation to people to preserve the forest? Do you see it as part of the solution to the deforestation problem?*

When people come to apply for a cutting permit, the officer gives them also some advice to plant new trees in order to compensate for the cut ones. Also, if they wish to obtain a permit for a large area, our policy is to give permits plot by plot, not for the whole area at once. We try to give away seedlings, but so far the numbers are limited.

**If we use Ubudehe as an example of community discussion on important issues, can such a discussion be applied to solve the deforestation problem?*

In ubudehe, deforestation is not raised as an issue. This is a proposal under way. Now we try to increase the awareness of tree owners on the importance of the forest and also to teach them how to increase their charcoal production efficiency.

7. If their forests are old, for instance, we try to provide them with seedlings and help them with the management of their forests. This forest management assistance also includes Umuganda. People help at the plantations.

8. Do you have an approximation of the rate of illegal tree cutting?

There was a time when the cutting permits were stopped. Then some people started to cut trees illegally. However, now the illegal cutting is at a low level because of the high fines enforced against tree cutting. If somebody cuts a tree from their own plantation without a permit the fine is 2000 Rwf but they can keep the tree. If the plantation is public then the fine is 5 000 Rwf and the tree is taken by the authorities. If a lot of people ask for cutting permit at the same time, then we give three per cell and to the most needy, poor ones.

*How do you ensure the security at the forest? Is there anybody guarding them?

There is nobody specifically responsible for that. People who live close by notify me if they see someone cutting trees. They have my phone number. Sometimes I buy them little treats to reward them.

9. Do strict permit regulations create room for illegal cutting?

People are discouraged to do it because of the high fines. If we remove the permits, a lot of people will start producing charcoal and sell in Kigali or other cities.

Kirehe ,Nasho sector

1. People mostly use firewood to cook and it mainly comes from natural forests.
2. In Nasho there is 100ha of government forest, 10 ha for the district, many hectares approximately 1000 ha (he is not sure) for private plantation. Nasho has also 30 ha of natural forest and it belongs to the government. The forest is increasing because every year they plant trees.
3. See question 2
4. People also burn crop residues because they do not have enough trees but the sector has put much effort in encouraging people to plant trees in their fields.
5. They plant trees to increase forests. They plant 50 000 seedlings every year in a sector but there is a problem of lands which are susceptible to soil erosion (marginal land) which are to be planted on trees but because these lands are owned by local people, these lands are used for agricultural activities.
6. At village meeting or any other activity that brings people together like Umuganda (public activity), the forest authority get time to address the issues about the forest.
7. No incentives are given to local people or investors.
8. So far no cases for illegal cutting.
9. They established the policy of cutting permits just to give a value to the forest. Before people were cutting trees without any restrictions. This was creating deforestation and now due to permits people reduced the way of cutting trees. No costs for cutting permits to those who want to cut the forest below 1.5 hectare. For those who have above 1.5 ha, they pay 2000 Rwf for the permits and pay also 1% of the value of that forest to be cut as tax.

*No one officially burns charcoal in the sector.

Forest Kirehe, Kigina sector

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1. There is 100 % wood fuel usage among sector villagers. Almost no one has biogas.
 2. The forest official in Kigina is responsible for three sectors. The area in Kigina is 250ha, 160 ha in Nyamugari and 203 ha in Kigarama. All of these are only government forest. The forest cover increase in each sector is: 10ha per year in Kigina and 12 ha increase per year in the other two sectors. Sometimes when different non-for-profit organizations and foundations take part into the reforestation efforts the rate of forest cover increase goes up.
 3. See question 2
 4. It is used mainly as fertilizer, not so much as an energy source.
 5. The government procures a budget for seedlings planting every year. At the sector they look for an area to plant. This is regarding the government forest. At a household level, seedlings are also given for free.
 6. Meetings with people to explain the situation; advice to first plant a tree and then cut a mature one; advice on improved cook stoves use
 7. On the sector level incentives are low.
 8. It happens at a very low level. Probably one tree gets cut without a permit once in a while.
 9. The regulations are needed.
 - *How do you decide if a tree is ready to be cut?
It depends on the purpose it is going to serve. For example, if a tree is to be used for building it can be around 15 year-old, if it is going to be used for timber -30 year-old.
 - *No one officially produces charcoal.
- Note from the forest officer: The monitoring is at a very low level and difficult.

Bugesera, Rweru sector

1. 9.5 ha district forest and 18 ha people's forest.
2. The forest is increasing with 65% per year.
3. See question 1
4. Mainly as fertilizer and not so much as an energy source.
5. In terms of achieving the target of 30% as area covered by forest the district has adopted the initiative of shifting the tree planting mechanisms from public administration to private companies. These companies do the follow up 2 years before the full payment
6. People plant a lot of trees but unfortunately many trees get damages by termites
7. There is no wage, no motivation because tree planting became a real investment. The motivation is that forest in bank credit may be a mortgage (Ingwate)
8. Not so much because our trees are in low age.
9. Because many laws and decrees consider deforestation as a crime.

* Is charcoal produced in your sector?

No body because the forest are at the lower number

Kamonyi, Kayumbu sector

1. 195 ha of forests (private, public, government); they are going to make another inventory on forest.

2. Forest is increasing in Kayumbu sector. Government trees are not cut; seedlings are planted.

3. See questions 1 and 2

4. As fertilizer.

5. They prepare seedlings every year. Tomorrow 4000 trees (a long roads). They started at November. They have no fixed number per year.

6. At general meetings, the issues are raised and try to explain the importance of forest and also when seedlings are planted, the occasion is used for forest awareness.

7. No incentives to the investors. Big forest is for the government; not for the private investors

8. For illegal cutting, there are few cases; if you want to cut one tree, no permit is required. 9. Only for big patches of land need permits. The ones selling wood or charcoal in kigali also ask for the transportation permits to the district.

*How can you prevent the wood leaving from your sector and being sold in Kigali markets? About wood moving out, she said that forest is for the owners. They cannot impose anything on them to keep it locally.
